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An assessment of the American plaice stock in NAFO Subarea 2 and Division 3K.

Évaluation du stock de plie canadienne dans la sous-zone 2 et la division 3K de l'OPANO.

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Abstract

The stock of American plaice in NAFO Subarea 2 plus Division 3K remains at a very low level. Catches have increased since 1999, due mainly to by-catch in the Greenland halibut fishery. The composition of the A. plaice by-catch in this fishery is composed mainly of sexually mature females. Research vessel surveys indicate that the stock size is currently about 3-5% of the values measured in the early 1980's. Stock size has remained at this low level for several years following the closure of the directed fishery. Changes in the distribution of the fish were observed in the mid- to late 1980's, and size and age at maturity declined through the mid 1990's but has stablized since then. Since the stock did not recover when catch levels were very low (mid to late 1990s), commercial catches do not appear to be a major contributor to the high mortality estimated in this stock. This is supported by recent catch/biomass ratios of less than 1%. Further, with no strong year-classes present in the population, and relatively high mortality rates, the prospects for stock rebuilding continue to be extremely poor.

Résumé

L'effectif du stock de plie canadienne de la sous-zone 2 et de la division 3K de l'OPANO demeure très faible. Depuis 1999, les prises de cette espèce ont augmenté, principalement en raison des prises accessoires lors de la pêche du flétan noir. Les prises accessoires de plie canadienne lors de cette pêche sont composées surtout de femelles ayant atteint la maturité sexuelle. Des relevés de navire de recherche révèlent que la taille actuelle du stock est environ égale à 3 à 5 % de ce qu'elle était au début des années 1980. La taille du stock est demeurée à ce bas niveau pendant plusieurs années à la suite de la fermeture de la pêche dirigée. Entre le milieu et la fin des années 1980, des changements ont été observés dans la répartition de la plie canadienne. La taille et l'âge à maturité de cette espèce ont baissé au milieu des années 1990, mais se sont stabilisés depuis. Puisque le stock ne s'est pas rétabli lorsque les niveaux de prises étaient très bas (du milieu à la fin des années 1990), la pêche commerciale ne semble pas être une des principales causes de la mortalité élevée estimée chez ce stock. Cette conclusion est appuyée par les récents rapports entre les prises et la biomasse qui se chiffrent à moins de 1 %. De plus, l'absence de classes d'âge abondantes au sein de la population et les taux de mortalité relativement élevés portent à croire que le rétablissement du stock continuera d'être médiocre.

Introduction

Assessment and TAC history

Stock assessments were conducted within ICNAF in the mid- to late 1970's, and then within CAFSAC from the early 1980's until the early 1990's. Since then, the stock has been assessed within DFO's regional assessment process (RAP) (Brodie et. al. 1993). TAC regulation began for this stock in 1974, and the TAC was 10,000 tons from 1982-92 (Table 1). After a reduction to 5,000 t for 1993, the FRCC recommended that there be no directed catch from this stock in 1994 and that by-catches be limited to 500 t. This advice was implemented at the beginning of 1994, and was followed by similar advice for 1995-97, although by-catches were limited to a maximum of 100 t per year in this period. The FRCC advice for 1998-2003 did not reference the 100 t figure, and the TAC for these years was set at 0.

Description of the fishery, TAC history

Catches increased steadily throughout the 1960's, peaking at 12,686 t in 1970 (Table. 1). Vessels from Poland and USSR took most of the catches in the 1960's. After the declaration of the 200 mile limit in 1977, catches by non-Canadian fleets were greatly reduced, with the result that the total catch from the stock exceeded 2,000 t on only 2 occasions after 1981. Reported catches from 1994 to 1999 were less than 30 t per year, mostly as by-catch in gillnet fisheries, and are by far the lowest in the time series. This was due to a drastic reduction in the TAC in 1994 (Table 1), as well as the moratorium and limited fisheries for northern (2J3KL) cod, which, after 1992, essentially eliminated a major source of A. plaice by-catch. An increase in the catch of A.plaice in 2000-2002 was observed, mainly as a result of by-catch from increased effort directed toward G.halibut in Div. 3K (Brodie and Power 2003). The main source of by-catch in 2000-2001 was the gillnet fishery for G.halibut, although the otter trawl fishery for this species took 89% of the by-catch of A. plaice in 2002.

In most years, a large percentage of the catch of this stock occurred in Div. 3K. Catches from Div. 2GH combined have not exceeded 125 t in any year since 1972 (Table 2), and have been negligible in many years (none reported since 1992). Only 2 tons of catch has been reported in Div. 2J from 1993-2002. In most years prior to 1991, the inshore catch from the stock ranged between 500 and 2,000 t. The offshore catch fluctuated widely, as it was often more economical for the offshore fleet to fish for A. plaice in the southern divisions of Subarea 3. The last significant offshore fisheries occurred in the autumn of 1989 and 1990 in Div. 2J, largely in conjunction with cod fisheries in the same area.

Catches of A. plaice discarded in the shrimp fishery in Subarea 2 + Div. 3K are estimated to be in the range of 7 -11 tons per year in 2000-2002, based on analysis of observer data collected at sea on the large and small vessel shrimp fleets (D.Orr, pers. comm.). Kulka (1995), using observer data, estimated catches of A. plaice to be 64 t on average for Div. 2J3KL combined in 1980-94 (range 0 – 228 t). Introduction of Nordmore grates in the shrimp fisheries in these areas in recent years has led to a reduction in finfish by-catch.

Commercial fishery data

CPUE data are available from Canadian offshore otter trawlers for the period 1976-92. However, only twice since 1981 did the directed catch of A. plaice exceed 500 t, and in many years it was very low. Offshore catches were negligible after 1991, and there has been no directed fishery for this stock since 1993. Therefore, CPUE data cannot be used as an index of abundance for this stock, and by-catch rates are not considered to be representative of stock abundance (Brodie et al. 1993).

Catch at age and mean weights at age

Catch at age data for this stock are available for 1976-82, and 1984-90, although attempts at using VPAs in the early 1980s were not successful (Brodie and Pitt 1982). For many years in the 1990's, due mainly to the very low catches (less than 30 t per year from 1994-99), there was either no sampling of the catches, or the sampling was not adequate to calculate catch at age (Brodie and Morgan 2000).

In 2001 and 2002, length and age samples were available from the A. plaice by-catch in the directed otter trawl fishery for G.halibut, which occurred in the deep water slope near the boundary between Div 3K and 3L (Table 3). By-catch from this fishery was almost 90% of the total reported catch in 2002, but only about a quarter of the reported catch in 2001. Most of the catch in both years was comprised of fish aged 9-11 years, with 15 being the maximum age observed. The peak ages are similar to those observed in the directed fisheries of the 1980's, although the age compositions in the earlier period contained fish as old as 19 in most years (Table 4). It is of some concern that the plaice by-catch sampled in 2001 and 2002 from the G.halibut fishery consisted of 97-98% females (Table 3).

Fig. 1 shows a comparison of the mean weights at age 10 from years in which sampling data were available. There is a considerable amount of variability in these data, likely related to sampling variability as well as location and timing of the fishery in the earlier years. The mean weights calculated for 2001 and 2002 (0.476 and 0.489 kg.) are close to the average of the 1976-90 period (0.464 kg.).

Age compositions from the by-catch of A. plaice in the large-vessel shrimp fishery from 2000 to 2002 indicate that most of the plaice caught are 2 and 3 years of age (D.Orr pers. comm.).

Research vessel survey data

Stratified random bottom trawl surveys have been conducted in Div. 2G, 2H, 2J, and 3K since the late 1970's, although not annually in Div. 2GH. In 1995, the survey trawl was switched from an Engel 145 Hi-lift trawl with bobbin footgear to a Campelen 1800 shrimp trawl with rockhopper footgear (McCallum and Walsh 1996). The Campelen trawl, with its smaller mesh throughout, was more effective in capturing small fish. A comparative fishing experiment was carried out to quantify the differences, and the results are contained in Warren (1996). Morgan and Brodie

(2000) converted the results of surveys in Div. 2J and 3K from 1978-94 into Campelen equivalents for A. plaice. The surveys in Div. 2GH were not converted.

From 1995-2002, the fall surveys covered Subarea 2 and Divisions 3KLMNO, although the coverage was not comparable in all years, particularly in Div. 2G, and inshore 3K. Table 5 shows the details of the surveys from 1995-2002. Some changes were introduced during this period, notably the addition of inshore strata in Div. 3K in 1996. The inshore strata were surveyed in 1996-98 and 2000-2002, but not in 1999. Div. 2H was surveyed in 2001 but Div. 2G has not been surveyed since 1999. Stratification schemes in use from 1997 onward are shown in Figs 2-5 for Divisions 2G, 2H, 2J, and 3K.

Abundance and biomass estimates

The trawlable biomass index of A. plaice in Div. 2G was relatively low (< 610 tons) in all surveys from 1996-99, although coverage was incomplete in all years (Table 6). Biomass was distributed mainly in the 201-300 m strata, and despite the poor coverage in deeper water, there were few A. plaice found deeper than 500 m, and none beyond 750 m. Div. 2G was not surveyed since 1999. In Div. 2H, the trawlable biomass estimate was 730 tons in 2001 (Table 7), the lowest level in the time series. The biomass in Div. 2H was more evenly distributed among depth zones, and some A. plaice were found in the 750-1000 m depth range. In Div. 2GH combined, the Engel biomass estimates declined substantially from a level in 1978-81 between 12,000 and 20,000 tons to around 4,000 – 7,000 tons in 1987-88 (Brodie et al. 1995). A Canadian survey in 1991, a Japanese survey in 1996 which gave a Div. 2GH biomass estimate for A. plaice of 446 tons (Yokawa and Satani, 1997), and the recent Campelen surveys show that this decline continued into at least the 1990's.

In Div. 2J, the trawlable biomass index declined drastically from estimates over 220,000 t in 1982-83 to estimates below 10,000 t in each year after 1991 (Fig. 6) Estimated biomass since the Campelen surveys started in 1995 has been less than 6000 tons in each year (Table 8). The biomass estimate for 2002 was 2554 t with an approximate 95% confidence interval of +/- 557 t. Div. 3K shows a similar pattern, with the biomass declining from a high of over 100,000 tons (1981, 1984) to between 5000 and 16,000 t in the 1992-2002 period (Table 9, Fig. 6). The 2002 estimate was 4261 t, with an approximate 95% confidence interval of +/- 572 t. These values represent the lowest biomass estimates in the time series for each Division. It should be noted that the inshore strata have been surveyed in Div. 3K for the past number of years, with the exception of 1996 and 1999, therefore these values, which are shown in Table 9, have been included in the annual totals. The inshore biomass estimates showed a decline between 2000-2002 (from 672 – 314 tons). Overall, inshore biomass in Div 3K has accounted for 5 to 9 % of the total biomass estimate in Div. 3K.

Age compositions (mean numbers per tow) from the Campelen surveys in Div. 2G and 2H are presented in Table 10. No fish beyond age 11 were found in Div. 2G, and only in low numbers in Div. 2H. For Div. 2GH combined, ages 2 and 3 were the most abundant age groups in the 1999 survey, and represented the largest catch of any year classes in the 4 year time series. In 2001, ages 3 and 4 were the most abundant age groups in Div. 2H. The 2002 survey in Div. 2J showed ages 5 and 6 were the dominant age classes (Table 11). In Div. 3K the dominant age classes were again ages 3 and 4, which was slightly younger than in previous years (Table 12).

Overall, the abundance index of American plaice for Div. 2J3K combined was at its lowest level in 2002, about 5% of the mean Campelen equivalent value for 1980-84 (Table 13).

There was a gradual reduction in the numbers of older fish caught in the 1980's surveys, consistent with the commercial fishery data in this period. Virtually all cohorts declined at very high rates from 1990 to 1993 (Tables 11-13) and in recent years there were few fish present >10 years old. However, there are a small number of older fish (>11 years) present in 2001 and 2002.

Distribution by depth and area

As was noted in Bowering et al. (1997), and in the 2000 assessment of this stock (Brodie and Morgan 2000), shifts in the depth distribution of the A. plaice biomass to deeper water occurred after the mid-1980's in surveys of both Div. 2J and 3K. These changes were followed by continued steep declines in the survey biomass to very low levels. In Div. 2J, plaice in the shallowest depth zone (101-200 m) accounted for 45 to 85 percent of the biomass (unconverted Engel data) in that division in the years 1977 to 1988. In 1989, this percentage dropped sharply to less than 5, and has remained less than 20% in all subsequent surveys. The proportion of biomass found in depths greater than 300 m was negligible in 2J prior to the late 1980's, but increased in the 1990's (Tables 8 and 9, Fig. 7). In Div. 3K, the proportion of biomass deeper than 300 m increased sharply from 1985 to 1986, and has remained at this higher proportion since then. It should be noted, for Div. 3K, that the strata in the 101-200 m depth range (618 and 619, Fig. 5) were added to the fall surveys in 1984, so prior to then there were no survey sets in this depth range in Div. 3K. Also, the inshore strata in Div. 3K were not included in these comparisons, as these strata were surveyed only in 1996-98, and 2000-02.

The spatial distribution of American plaice in 2002 is seen in Fig. 8a in number of fish per tow, and in Fig. 8b in weight of fish per tow. Fish are widely distributed throughout Subarea 2 and Division 3K in 2002, but at very low densities. Compared with 1999, there are few large catches in the southern portion of Division 3K and most of the catches are off the northeast coast of Newfoundland. There are a number of sets with no A. plaice catches, across the banks of 2J and 3K and into the deeper strata.

The concentrations of A. plaice on Hamilton Bank and in the southwestern portion of Div. 2J, present in most surveys up to 1988, were generally not found in subsequent surveys (Brodie et al. 1995). In 1989 and 1990, before the biomass declined to the current low level, A. plaice in Div. 2J were found to the east of Hamilton Bank, and south in the Hawke Channel. Similar changes were observed in Div. 3K, with A. plaice becoming less abundant in the shallower shelf areas west of Funk Island Deep. Presently there does not appear to be any significant concentrations of A. plaice in Div. 2J3K. Fig. 9 shows a comparison of the distribution patterns observed in the Campelen surveys of 1999-2002.

Maturity at Age and Size

Proportions mature at age were calculated according to the method described in Morgan and Hoenig (1997) to correct for bias introduced by length-stratified sampling.

Maturities were modelled by cohort using generalized linear models with a logit link function and binomial error (McCullagh and Nelder, 1983):

$$\text{pmat} = \left(\frac{1}{1 + exp(-u)} \right)$$

where: *pmat*= proportion mature at age or length

$$u = \tau + \delta_j v_i + \beta_j$$

τ = intercept

v_i = age i or length i

δ_j = combined age*cohort effect for cohort j

β_j = cohort effect

Before a cohort was included in the model it was first tested separately to ensure that there was sufficient data to which to fit a model. Age and length at 50% maturity (A_{50} and L_{50}) along with 95% fiducial limits were produced for cohorts with both a significant slope and intercept. These were then included in the overall model to test for significant cohort effects and to produce estimates of proportion mature at age for Div. 2J3K combined for each cohort. 1 has been added to all ages to be consistent with spawning in the spring following the fall survey.

There has been a significant decline in age at maturity for both males (χ^2=411, df=26, p<0.0001) and females (χ^2=1514, df=33, p<0.0001). A_{50} showed a fairly substantial decline for both sexes from about the 1970 to 1990 cohort, declining from almost 11 years to 7.5 years for females and from almost 7 years to 4 years for males (Figure 10). Since the 1990 cohort A_{50} has been fairly stable.

Length at maturity also exhibited significant variability across cohorts for both males (χ^2=740, df=31, p<0.0001) and females (χ^2=2910, df=34, p<0.0001). L_{50} declined from 40 to 38 cm for females and from 24 to 15 cm for males (Figure 11). The large increase for the most recent cohort for females has wide fiducial limits and may change when more data are added from future surveys.

Spawning Stock Biomass

Estimates of female spawning stock biomass were produced using the estimated proportion mature at age as described above, the female number at age in the survey, the mean length at age and a standard length/weight relationship of:

$Log_{10}\, weight = (3.3247 * Log_{10}\, length - 5.553)$

Since the fish captured in the fall surveys will not spawn until the next spring the SSB calculated for the fall of year *y* was assumed to be the SSB in the spring of year *y+1*, giving rise to cohort *y+1*.

Although the female SSB index was variable from 1979 to 1987, the average over that period was just under 100 000 (Figure 12). The index then declined precipitously to 3 400 in 1996, less than 5% of the 1979-1987 average. The index increased slightly to the 2000 spawning season but declined again after that. The current estimate of the female SSB index for Div. 2J3K is 3 600.

Relative Cohort Strength

Cohort strengths were estimated using the following model using Campelen or equivalent data from spring RV surveys from 1978 to 2002:

$$\log(N_{ajt}) = \tau + \alpha_a + \delta_j + \varepsilon$$

where: N_{ajt} = number at age *a* belonging to cohort *j* in year *t*

τ = intercept

α_a = age effect for ages *a*=3...5

δ_j = cohort effect

ε =residuals from the fitted model

This model showed a significant fit to the data and no obvious pattern in the residuals (Figure 13).

R-Square	Coeff Var	Root MSE	logn Mean
0.808169	20.45317	0.592130	2.895051

Source	DF	Type I SS	Mean Square	F Value	Pr > F
age	2	28.41027980	14.20513990	40.51	<.0001
cohort	24	39.53753805	1.64739742	4.70	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
age	2	24.09554658	12.04777329	34.36	<.0001
cohort	24	39.53753805	1.64739742	4.70	<.0001

All cohorts prior to 1987 (with the exception of the 1976 and 1977 cohorts) were significantly greater than the most recent estimated cohort (Figure 14). There has been a decline in cohort strength since 1993 and the last 3 cohorts (1996-1998) are estimated to be low.

Stock Recruit

The number of 3 year olds estimated from the relative cohort strength model was plotted against the female SSB index (Figure 15). There is an indication of a stock recruit relationship with better recruitment at a higher female SSB index. All of the best recruitment is above an SSB index of 65 000. The current index of female SSB is 3 600, well below the level where a large number of recruits would be expected.

The number of recruits per ton of SSB (R/S) was also calculated. R/S has been above average for the 1992 through 1998 cohorts. However, since SSB was very low the actual number of recruits produced is not large (Figure 16).

Mortality

Mortality was calculated as $\ln(N_{ay}/N_{a+1,y+1})$ for each age from 1 to 16 (Figure 17). For most ages mortality has either shown an almost continual increase over the time period or has increased and then levelled off at about 1990 at the higher mortality. Average Z on ages 5 to 10 over the last 5 years (1997-2002) has been very high at 0.76.

Catch/Biomass Ratio

Catch divided by the index of survey biomass (C/B) gives a proxy for fishing mortality, and the time series of C/B ratios is shown in Fig. 18. Biomass estimates are Campelen equivalents for Div. 2J and 3K combined, and the catches are the reported data for Subarea 2+ Div. 3K combined (Tables 1 and 2). For much of the time period when surveys were available, a substantial part of the commercial catch occurred during the first quarter of the year. Thus the survey estimates of biomass, which were generally from November-December, were taken to represent the biomass on January 1 of the following year. The analysis showed that the C/B ratios were all less than 4%, exceeding 3% on only 2 occasions. C/B ratios have been less than 0.35% each year from 1992-99 (below 0.1% from 1997-99). During the years of the largest stock decline (1982-88), the C/B ratio did not reach 2%, and was around 0.5% for 1983-85. Morgan et al. (2000), in a more detailed examination of these and other data, concluded that fishing mortality could not explain the decline in biomass of this stock which occurred from the early 1980's to the early 1990's. C/B increased after 1999, as catch increased and survey biomass declined, but still remained below 1% (Fig. 18).

Consumption of A. plaice by harp seals

Hammill and Stenson (2000) estimated consumption of A. plaice by harp, hood, grey, and harbour seals in Divisions 2J3KL (not the stock area of SA 2+ Div. 3K), at 15,141 tons in 1996. However, it was also estimated that during 1996, seals consumed 179,224 tons of *Pleuronectidae* (flatfish) in 2J3KL, which could not be identified to the species level from otoliths in the seal stomachs. Based on the flatfish species present in the area, most of this total likely consisted of A. plaice and witch flounder. There are no new predation estimates available at this time.

Assessment

The stock of American plaice in NAFO Subarea 2 plus Division 3K showed a large decline from the early 1980's to the early 1990's and still further decline to the present. The stock size in numbers is currently about 3-5% of the values measured in the early 1980's. Stock size has remained at a very low level following the closure of the directed fishery in 1994. Total mortality rates are estimated to be higher in the most recent years than in the 1980's and even the 1990's. Changes in the distribution of the fish were observed in the mid to late 1980's, and size and age at maturity declined through the mid 1990's. There has been an increase in the by-catch of A. plaice composed almost entirely of females aged 9-11. Since the stock did not recover when catch levels were very low (mid to late 1990s), commercial catches do not appear to be a major contributor to the high mortality estimated in this

stock. This is supported by recent catch/biomass ratios of less than 1%. With no strong year-classes present in the population, and relatively high mortality rates, the prospects for stock rebuilding continue to be extremely poor.

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Table 1. Nominal catches (1963-2002) and TACs (1974-2003) of American plaice, NAFO Subarea 2 + Division 3K. All values in metric tons.

	Canada							
Year	Inshore	Offshore[a]	Total	Poland	USSR	Other	Total	TAC
1960			15				16	
1961			67				67	
1962			60				64	
1963	116	-	116	675	627	3	1,421	
1964	95	-	95	1,678	1,268	27	3,068	
1965	224	-	224	3,195	2,155	14	5,558	
1966	228	-	228	1,860	765	96	2,949	
1967	395	-	395	1,134	1,701	361	3,591	
1968	1,023	-	1,023	1,889	2,911	128	5,951	
1969	1,689	-	1,869	867	4,129	217	6,902	
1970	3,751	-	3,751	378	8,160	397	12,686	
1971	2,486	-	2,486	233	2,597	32	5,348	
1972	1,188	9	1,197	849	6,760	315	9,121	
1973	1,368	16	1,384	225	3,011	520	5,140	
1974	462	106	568	91	4,643	318	5,620	10,000
1975	813	46	859	95	4,449	344	5,747	8,000
1976	1,741	736	2,477	118	3,373	139	6,107	8,000
1977	1,925	4,691	6,616	27	698	184	7,525	8,000
1978	1,723	1,452	3,175	138	123	86	3,522	6,000
1979	1,792	1,058	2,850	31	39	45	2,965	6,000
1980	1,140	3,746	4,886	39	26	89	5,040	6,000
1981	1,069	6,322	7,401	58	56	30	7,545	6,000
1982	576	1,265	1,841	13	8	38	1,900	10,000
1983	445	863	1,308	266	11	48	1,633	10,000
1984	559	502	1,061	81	6	27	1,175	10,000
1985	558	160	718	14	7	14	753	10,000
1986	1,007	1,903	2,910	1	39	68	3,018	10,000
1987	737	165	902	38	111	12	1,063	10,000
1988	630	252	882	41	21	9	953	10,000
1989	861	3,291	4,152	84	8	4	4,248	10,000
1990	573	1,225	1,798	-	29	-	1,825	10,000
1991	212	282	494	-	14	2	510	10,000
1992	82	21	103	-	-	-	104	10,000
1993	1	76	77	-	-	-	77	5,000
1994			16	-	-	-	16	500[b]
1995			28	-	-	-	28	100[b]
1996			16	-	-	-	16	100[b]
1997			9	-	-	-	9	100[b]
1998			2	-	-	-	2	0
1999			7	-	-	-	7	0
2000			67	-	-	-	67	0
2001			137	-	-	-	137	0
2002			98	-	-	-	98	0
2003[c]			34	-	-	-	34	0

[a] Includes some catches by inshore otter trawlers in some years.
[b] By-catch only.
[c] Data for 1995-2003 are provisional. Data for 2003 are up to Oct. 6.

Table 2. Nominal catches (t) of A. plaice in SA 2 + Div 3K, by Division, 1960-2003.

Year	2G	2H	2J	3K	Total
1960					16
1961					67
1962					64
1963	0	0	238	1183	1,421
1964	0	21	1193	1854	3,068
1965	1	694	2657	2236	5,588
1966	2	102	575	2270	2,949
1967	1	440	1267	1883	3,591
1968	0	32	938	4981	5,951
1969	1	160	2268	4473	6,902
1970	11	103	2128	10444	12,686
1971	746	58	925	3619	5,348
1972	1	196	4818	4106	9,121
1973	0	26	1788	3326	5,140
1974	0	11	938	4671	5,620
1975	73	0	1101	4573	5,747
1976	24	43	645	5395	6,107
1977	0	0	224	7301	7,525
1978	1	49	145	3327	3,522
1979	0	11	221	2733	2,965
1980	0	36	142	4862	5,040
1981	0	38	96	7411	7,545
1982	0	108	204	1588	1,900
1983	0	124	168	1341	1,633
1984	0	54	92	1029	1,175
1985	0	11	34	708	753
1986	0	4	100	2914	3,018
1987	0	1	239	823	1,063
1988	0	50	106	797	953
1989	0	9	3225	1014	4,248
1990	1	1	991	816	1,809
1991	0	1	69	428	498
1992	0	1	5	97	103
1993	0	0	0	77	77
1994	0	0	0	16	16
1995	0	0	0	28	28
1996	0	0	1	16	17
1997	0	0	1	9	10
1998	0	0	0	2	2
1999	0	0	0	7	7
2000	0	0	0	67	67
2001	0	0	0	137	137
2002	0	0	0	98	98
2003	0	0	0	34	34

Data for 1995-2003 are provisional.
Reported catch in 2003 is up to October 6.

Table 3. Catch at age (000's of fish) and mean lengths & weights at age, 2+3K plaice, 2001 & 2002.
All data taken from A. plaice by-catches in the directed otter trawl fishery for Greenland halibut.

2001	Average			
Age	Len (cm)	Wgt (kg)	No. caught	SOP (t)
6				
7	34.33	0.358	2	0.72
8	34.09	0.354	6	2.12
9	35.94	0.422	15	6.33
10	37.18	0.476	20	9.52
11	39.48	0.579	16	9.26
12	42.07	0.721	5	3.61
13	45.39	0.914	1	0.91
14	49.26	1.188	0.2	0.24
15	50.50	1.288	0.02	0.03
16				

Catch = 33 tons
S.O.P = 32.7

2002	Average			
Age	Len (cm)	Wgt (kg)	No. caught	SOP (t)
6	32.45	0.296	0.1	0.03
7	32.63	0.302	1	0.30
8	35.75	0.411	26	10.69
9	36.52	0.443	63	27.91
10	37.53	0.489	43	21.03
11	39.59	0.58	32	18.56
12	42.89	0.759	9	6.83
13	46.35	0.991	2	1.98
14	46.50	0.979	0.2	0.20
15				
16				

Catch = 87 tons
S.O.P.= 87.5

Table 4. Comparison of catch at age from 1980 and 2002, 2+3K. A.plaice
Catch numbers are thousands of fish. Catch in 1980=5040 t, 2002=87 t.

Age	**1980**	**2002**
6	10	0.1
7	83	1
8	231	26
9	772	63
10	2158	43
11	1751	32
12	1682	9
13	1097	2
14	502	0.2
15	253	
16	173	
17	46	
18	33	
19	8	

Table 5. Summary of sets in Campelen fall surveys in SA 2+3 in 1995 - 2002. Depth range is given in meters, numbers of sets appear in parentheses.

Year	Division	Ship				Year	Division	Ship			
		Teleost	*W.Templeman*	*A.Needler*	***Total***			*Teleost*	*W.Templeman*	*A.Needler*	***Total***
1995	2G	Not surveyed in 1995				1999	2G	142-1415(69)			69
	2H						2H	104-1454(81)			81
	2J	145-948 (84)			84		2J	109-1375(115)			115
	3K	166-1444 (31)	162-494 (100)		131		3K	146-1477(154)			154
					215						**419**
1996	2G	127 - 1436 (47)			47	2000	2G	Not surveyed in 2000			
	2H	122 - 1415 (77)			77		2H				
	2J	126 - 1410 (117)			117		2J	127-1400 (117)			117
	3K	111 - 1368 (115)	126 - 472 (60)		175		3K	113-1379 (159)			159
					416						**276**
1997	2G	201-1209 (69)			69	2001	2G	Not surveyed in 2001			
	2H	220-1382 (71)			71		2H	999-1466 (8)		117-655 (49)	57
	2J	123-1488 (117)			117		2J	120-1389 (49)		105-574 (71)	120
	3K	143-1431 (155)	117-421 (20)		175		3K	146-1479 (106)	128-439 (55)	170-252 (4)	165
					432						**342**
1998	2G	143-1488 (34)			34	2002	2G	Not surveyed in 2002			
	2H	98-1473 (83)			83		2H				
	2J	126-1398 (118)			118		2J	102-1372 (98)	136-572 (19)		117
	3K	122-1415 (154)	121-346 (17)		171		3K	156-1395 (64)	121-481 (111)		175
					415						**292**

1995 fall survey extended into January 1996
2002 fall survey extended into January

Table 6. Biomass (t) per stratum of A. plaice from fall Campelen surveys, Div. 2G, 1996-99.

stratum	depth(m)	1996	1997	1998	1999
909	<200	55		67	3
910	<200	0		4	50
925	<200	0			1
901	201-300	172	57		120
908	201-300	37	56	111	115
911	201-300	130	68	88	109
924	201-300	0	51		45
926	201-300	3	7		0
902	301-400	6	8	0	10
912	301-400		1	0	0.2
923	301-400	35	49		13
927	301-400	6	0		0
903	401-500		4	0	1
913	401-500		0.3	0	3
922	401-500		0		5
928	401-500	18	21		4
904	501-750		6	1	14
914	501-750		0	2	2
921	501-750		0		4
929	501-750	0	7		
905	751-1000			0	0
915	751-1000				
920	751-1000				
906	1001-1250		0	0	0
916	1001-1250			0	
919	1001-1250		0		
907	1251-1500				0
917	1251-1500				
918	1251-1500				

Sum	<200	55.0		71.0	71.0
	201-300	342.0	239.0	199.0	438.0
	301-500	65.0	83.3	0.0	83.3
	>500	0.0	13.0	3.0	16.0
	Total	462.0	335.3	273.0	608.3
Proportion					
	<200	0.119		0.260	0.117
	201-300	0.740	0.713	0.729	0.720
	301-500	0.141	0.248	0.000	0.137
	>500	0.000	0.039	0.011	0.026

Table 7. Biomass (t) per stratum of A. plaice from fall Campelen surveys, Div. 2H, 1996-2001.

stratum	depth (m)	1996	1997	1998	1999	2001
930	<200	49		98	148	11
954	<200	89		53	85	76
956	<200	163		72	106	82
957	<200	100		33	27	17
931	201-300	184	32	56	72	
943	201-300	0	5	10	16	
950	201-300	86	9		15	3
953	201-300	24	40	38	26	33
955	201-300	90	80	67	26	42
958	201-300	48	98	59	98	10
932	301-400	6	8	2	6	
944	301-400	41	111	81	98	
949	301-400	98	26			8
952	301-400	12	204	2	54	51
959	301-400	7	7	1	9	45
933	401-500	4	4	8	8	
942	401-500	0.3	0.5	0.1	2	0
945	401-500	16	90	81	26	65
948	401-500	8	96	126		8
951	401-500	89	11	20	26	64
960	401-500	0.4	13	8	24	34
934	501-750	1	17	9	16	
941	501-750	1	0	0	9	17
946	501-750	66	74	41	120	95
947	501-750	13	26	34	84	14
961	501-750	10	13	12	25	57
935	751-1000		7	12	0	
940	751-1000	0	0	5	0	
962	751-1000	0	5	0	0	
936	1001-1250		0	0		0
939	1001-1250	0	0		0	
963	1001-1250	0	0	0	0	
937	1251-1500		0	0		0
938	1251-1500	0	0	0	0	0
964	1251-1500	0	0	0	0	
Sum	<200	401.0		256.0	366.0	185.4
	201-300	432.0	264.0	230.0	253.0	88.3
	301-500	281.7	570.5	329.1	253.0	274.0
	>500	91.0	142.0	113.0	254.0	182.7
	Total	1205.7	976.5	928.1	1126.0	730.3
Proportion						
	<200	0.333		0.276	0.325	0.254
	201-300	0.358	0.270	0.248	0.225	0.121
	301-500	0.234	0.584	0.355	0.225	0.375
	>500	0.075	0.145	0.122	0.226	0.250

Table 8. Biomass (t) per stratum of A. plaice from fall Campelen surveys, Div. 2J, 1995 to 2002.

Depth Range (m)	Stratum	Area (sq. nm)	Trawlable Units (000)	1995	1996	1997	1998	1999	2000	2001	2002
101-200	201	633	87.076		89	10	94	20	72	46	12
	205	1594	219.272		133	52	148	154	124	57	11
	206	1870	257.239	74	89	239	452	204	92	75	67
	207	2264	311.438	18	37	131	113	50	21	0	0
	237	733	100.832	0	31	15	2	39	9	6	0
	238	778	107.022		7	5	18	65	3	0	0
201-300	202	621	85.425	0	242	71	225	94	53	154	58
	209	680	93.542	122	94	137	84	141	123	0	81
	210	1035	142.376	158	336	210	174	250	61	12	84
	213	1583	217.759	86	174	492	542	446	357	813	295
	214	1341	184.469	49	257	260	334	327	355	433	211
	215	1302	179.105	16	426	132	272	174	230	210	115
	228	2196	302.084	351	704	706	648	391	325	463	52
	234	530	72.907		1	74	58	7	11	3	8
301-400	203	487	66.992	251	205	126	157	234	158	14	46
	208	588	80.886	593	49	1320	659	656	491	130	218
	211	251	34.528	80	42	60	96	390	70	68	38
	216	360	49.522	61	84	109	46	46	83	88	100
	222	450	61.902	9	117	132	65	87	156	70	6
	229	536	73.733	77	52	44	103	131	107	41	33
401-500	204	288	39.618	72	329	187	211	69	166	125	274
	217	241	33.152	91	31	80	47	9	51	27	43
	223	158	21.735	47	30	26	46	51		21	2
	227	598	82.262	69	108	88	109	58	105	77	42
	235	414	56.950	261	170	174	383	305	51	146	92
	240	133	18.296	14	9	0	0	12	8	20	9
501-750	212	557	76.622	670	144	283	220	228	329	275	337
	218	362	49.797	101	130	117	79	83	34	85	49
	224	228	31.364	65	264	118	128	12	86	127	52
	230	185	25.449	72	17	20	19	27	15	9	9
	239	120	16.507	109	151	57	60	71	24	82	113
751-1000	219	283	38.930	41	19	0	29	14	0	0	17
	231	186	25.586	78	0	0	11	0	16	26	0
	236	193	26.549	116	0	8	14	2	155	34	16
1001-1250	220	303	41.681		0	0	0		0	0	53
	225	195	26.824		4	9	0	6	5	0	0
	232	228	31.364		0	0	0	0	0	0	0
1251-1500	221	330	45.395		0	0	0	0	0	0	0
	226	201	27.650		0	0	0	0	6	0	0
	233	237	32.602		0	0	0	0	0	0	10
101-200		7872	1082.879	92	386	452	827	532	322	184	90
201-300		9288	1277.667	782	2234	2082	2337	1830	1515	2089	904
301-500		4504	619.576	1625	1226	2346	1922	2048	1446	828	903
>500		3608	496.320	1252	729	612	560	443	672	637	656
Total		25272	3476.442	3751	4575	5492	5646	4853	3954	3738	2554
Proportion											
101-200		0.311		0.025	0.084	0.082	0.146	0.110	0.081	0.049	0.035
201-300		0.368		0.208	0.488	0.379	0.414	0.377	0.383	0.559	0.354
301-500		0.178		0.433	0.268	0.427	0.340	0.422	0.366	0.221	0.354
>500		0.143		0.334	0.159	0.111	0.099	0.091	0.170	0.171	0.257

Table 9. Biomass (t) per stratum of A. plaice from fall Campelen surveys, Div. 3K, 1995 to 2002.
Inshore strata not surveyed in 1995 and 1999. Strata 611 and 621 modified slightly in 1997.

Depth Range(m)	Stratum	Area (sq. nm.)	Trawlable units ('000)	1995	1996	1997	1998	1999	2000	2001	2002
	INSHORE										
101-200	608	798	109.774		56	27	31		56	0	57
	612	445	61.215		26	49	11		9	1	4
	616	250	34.390		27	4	1		0	15	0
201-300	609	342	47.046		45	76	29		2	0	5
	611	573	78.823		37	100	247		114	21	71
	615	251	34.527		140	72	70		24	55	25
301-400	610	256	35.216		405	445	156		278	194	59
	614	263	36.179		62	199	211		187	102	90
401-500	613	30	4.127		12	20	8		2	14	3
	OFFSHORE										
101-200	618	1347	185.295	38	7	26	42	20	19	7	1
	619	1753	241.145	78	4	15	10	17	2	1	17
201-300	620	2545	350.093	190	310	394	169	101	131	59	32
	621	2537	348.992	1547	938	666	775	631	497	169	317
	624	1105	152.005	112	193	320	275	305	157	167	26
	634	1555	213.907	291	316	860	431	261	46	115	40
	635	1274	175.253	112	190	438	583	428	111	1	35
	636	1455	200.151	440	536	707	627	614	254	113	27
	637	1132	155.719	230	368	260	631	657		139	86
301-400	617	593	81.574	39	181	337	319	204	288	178	91
	623	494	67.955	81	129	180	195	93	150	302	57
	625	888	122.154	72	224	380	178	133	145	161	0
	626	1113	153.105	471	691	663	882	662	376	299	370
	628	1085	149.254	506	789	416	1260	690	754	1597	559
	629	495	68.093	369	290	157	252	260	185	192	91
	630	332	45.670	163	229	74	152	153	194	83	71
	633	2067	284.339	431	692	572	306	404	326	289	111
	638	2059	283.238	948	1528	1116	1939	1736	1847	1325	323
	639	1463	201.252	310	867	565	694	814	1070	438	200
401-500	622	691	95.055	191	143	287	648	327	413	317	171
	627	1255	172.639	1367	996	652	2051	2040	1167	506	527
	631	1321	181.718	566	485	314	239	367	469	343	293
	640	69	9.492	13	26	14	8	38	43	24	16
	645	216	29.713	3	42	2	23	30	36	8	18
	650	134	18.433	33	56	201	49	76		36	60
501-750	641	230	31.639	65	82	23	7	197		98	124
	646	325	44.707	0	111	0	0	18	217	87	37
	651	359	49.384	216	67	108	163	353		481	196
751-1000	642	418	57.501	115	0	0	0	0	231	22	0
	647	360	49.522	6	108	54	0	0	0	374	0
	652	516	70.982	636	1131	335	147	85	765	11	51
1001-1250	643	733	100.832	15	0	9	0	0	0	27	0
	648	228	31.364		0	0	0	0	9	13	0
	653	531	73.045	18	22	0	21	0	0	0	0
1251-1500	644	474	65.204	0	0	0	0	0	0	0	
	649	212	29.163		0	0	0	0	0	0	
	654	479	65.892	0	0	0	0	0	0	0	
Inshore		1347	185.295		810	992	764		672	403	314
101-200		3100	426.440	116	11	41	52	37	21	8	18
201-300		11603	1596.120	2922	2851	3645	3491	2997	1196	763	564
301-500		14275	1963.684	5563	7368	5930	9195	8027	7464	6098	2958
>500		4865	669.235	1071	1521	529	338	653	1221	1114	408
Total		35190	4840.774	9672	12561	11137	13840	11714	10574	8385	4261
Proportion											
Inshore		0.038			0.064	0.089	0.055		0.064	0.048	0.074
101-200		0.088		0.012	0.001	0.004	0.004	0.003	0.002	0.001	0.004
201-300		0.330		0.302	0.227	0.327	0.252	0.256	0.113	0.091	0.132
301-500		0.406		0.575	0.587	0.532	0.664	0.685	0.706	0.727	0.694
>500		0.138		0.111	0.121	0.047	0.024	0.056	0.116	0.133	0.096

Table 10. Mean number of American plaice per tow from Campelen surveys in Div. 2GH, 1996-2001.

2G

Age	1996	1997	1998	1999
0				
1	0.01		0.16	0.15
2	0.09	0.05	0.22	0.59
3	0.02	0.19	0.36	0.56
4	0.14	0.05	0.46	0.49
5	0.42	0.12	0.25	0.61
6	0.39	0.27	0.14	0.23
7	0.24	0.28	0.24	0.11
8	0.09	0.24	0.19	0.14
9	0.03	0.20	0.07	0.09
10		0.04	0.02	0.01
11		0.04	0.01	
12				
13				
14				
15				
16				
unk	0.02			
Total	**1.45**	**1.48**	**2.12**	**2.98**

2H

Age	1996	1997	1998	1999	2001
0					0.08
1	0.27		0.05	0.33	0.06
2	0.81	0.09	1.25	3.19	0.08
3	0.35	0.34	0.95	3.27	2.02
4	0.82	0.23	1.09	1.52	3.09
5	1.24	0.50	0.93	1.43	0.93
6	1.07	0.73	0.44	0.63	0.32
7	0.75	1.02	0.52	0.32	0.17
8	0.24	0.96	0.23	0.25	0.13
9	0.10	0.50	0.20	0.18	0.07
10	0.01	0.16	0.07	0.06	0.08
11		0.06	0.04	0.06	0.01
12		0.02	0.01		
13	0.01	0.02			
14		0.01	0.02		
15	0.01	0.01	0.01		
16					
unk					0.04
Total	**5.68**	**4.65**	**5.81**	**11.24**	**7.00**

Table 11. Mean number per tow of American plaice, by age, from fall surveys in Div. 2J. Data inCampelen equivalents

Age/Year	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.03	0.55	0.27	0.08	0.00	0.12	0.14
2	0.00	0.00	0.00	0.16	0.13	0.00	0.00	0.25	0.00	0.14	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.50	0.44	0.48	0.86	0.58	0.29	0.10	0.22
3	0.40	0.00	0.00	0.16	1.71	0.42	0.00	0.64	2.82	0.88	0.00	0.92	0.49	0.71	0.00	0.00	0.00	0.22	1.19	1.24	0.70	1.18	1.10	0.39	0.23
4	6.34	3.08	0.72	3.34	2.07	4.48	2.47	0.98	2.49	3.52	1.26	2.62	1.54	1.27	0.78	1.04	1.61	1.01	1.70	1.83	0.94	0.77	0.98	0.75	0.40
5	30.20	15.48	4.04	10.38	14.14	6.34	5.80	7.63	5.48	3.14	5.55	9.22	3.98	5.24	2.91	2.45	2.16	1.06	2.38	2.13	2.00	2.53	1.56	1.17	0.69
6	64.82	43.65	20.61	41.02	27.20	23.62	12.89	17.95	13.85	11.28	9.80	20.74	13.08	8.94	4.70	5.70	5.27	1.89	2.40	2.09	2.62	1.99	1.15	1.01	0.88
7	78.74	54.89	72.78	41.35	61.20	54.18	29.36	28.80	20.64	10.96	12.33	15.45	14.91	6.82	5.34	3.91	5.64	2.80	0.88	1.72	2.24	1.17	0.87	0.79	0.47
8	42.75	38.98	42.02	24.47	58.26	47.33	29.83	25.01	15.68	8.84	12.75	13.85	8.66	4.64	2.38	2.55	2.58	1.83	0.34	1.22	0.87	0.85	0.52	0.44	0.21
9	30.28	16.48	17.92	6.86	44.77	20.41	16.96	15.82	10.95	5.02	8.72	9.01	6.31	1.57	0.76	0.49	0.48	0.31	0.05	0.59	0.45	0.25	0.35	0.23	0.23
10	12.55	6.69	8.98	4.39	15.33	12.57	6.05	4.33	4.06	3.03	4.57	3.33	3.60	0.48	0.24	0.25	0.11	0.03	0.01	0.21	0.18	0.07	0.10	0.15	0.08
11	5.93	2.56	4.49	1.58	4.92	6.20	3.08	1.62	1.05	0.89	1.62	2.00	0.94	0.23	0.14	0.07	0.01	0.01	0.00	0.05	0.03	0.01	0.08	0.03	0.09
12	4.34	3.15	3.86	0.63	2.97	1.77	1.01	1.02	0.86	0.54	0.58	0.70	0.59	0.08	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.05
13	3.58	1.84	1.69	0.05	1.83	1.13	0.84	0.49	0.38	0.21	0.23	0.16	0.20	0.03	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.01
14	1.64	0.55	1.00	0.00	0.80	0.29	0.15	0.08	0.08	0.05	0.02	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	1.17	0.14	0.30	0.00	0.15	0.11	0.06	0.00	0.03	0.01	0.00	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.56	0.06	0.13	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.19	0.00	0.05	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unk	0.37	0.00	0.00	0.06	0.02	0.01	0.30	0.27	0.00	0.39	0.00	0.01	0.00	0.04	0.00	0.00	0.00	0.02	0.01	0.03	0.01	0.00	0.02	0.00	0.00
TOTAL	**283.88**	**187.55**	**178.61**	**134.45**	**235.60**	**178.87**	**108.80**	**104.89**	**78.39**	**48.90**	**57.43**	**78.35**	**54.33**	**30.05**	**17.32**	**16.47**	**17.86**	**9.76**	**9.43**	**12.15**	**11.17**	**9.49**	**7.02**	**5.20**	**3.70**

Table 12. Mean number per tow of American plaice, by age, from fall surveys in Div. 3K. Data converted to Campelen equivalents

Age/Year	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.20	0.00	0.00	0.00	0.00	0.08	0.00	0.20	0.21	0.13	0.00	0.15	0.00	0.00	0.00	0.00	0.14	0.03	0.08	0.09	0.05	0.22	0.27	0.07
2	0.00	0.00	0.22	0.00	0.17	0.11	1.02	2.47	1.14	0.57	2.64	1.15	0.00	0.16	0.02	0.00	0.73	1.99	0.40	0.08	0.38	0.20	0.24	0.60	0.54
3	3.22	0.18	1.26	1.54	3.31	5.90	1.67	2.62	16.99	4.96	4.21	6.60	1.19	0.36	0.94	1.08	0.58	1.19	3.86	0.30	0.73	0.35	0.29	0.72	1.13
4	50.56	4.25	1.32	1.92	3.74	5.40	11.77	4.69	16.32	15.49	7.16	10.00	2.82	3.64	1.28	3.20	2.13	1.95	6.16	1.69	1.36	0.77	0.80	0.45	0.71
5	84.34	18.61	8.30	6.09	5.56	12.07	11.91	9.88	10.87	10.92	20.76	10.47	4.86	6.96	4.07	8.21	3.71	4.17	6.69	5.31	4.01	2.09	1.71	0.99	0.63
6	85.28	27.85	19.45	10.15	9.74	16.00	22.33	10.25	13.84	11.58	10.40	17.84	6.29	6.95	5.40	9.55	5.91	5.78	3.82	5.28	4.08	3.81	2.48	1.27	0.65
7	51.67	24.97	32.64	23.53	14.35	19.17	14.40	12.01	10.22	9.39	6.95	11.27	6.52	5.08	3.84	3.98	9.08	4.19	1.33	2.36	3.52	2.69	2.20	1.03	0.53
8	21.15	17.46	15.97	23.32	13.94	13.39	18.03	8.24	9.27	6.51	4.83	4.74	3.14	2.42	1.63	2.16	2.70	1.70	0.21	0.95	1.93	1.47	1.19	1.10	0.44
9	16.56	9.84	7.63	9.12	8.17	4.02	6.96	4.75	6.23	4.25	2.85	4.13	1.82	1.32	0.81	0.63	0.70	0.39	0.10	0.80	0.73	0.77	0.51	0.59	0.35
10	9.10	5.26	4.98	7.70	3.39	2.72	2.92	2.02	2.96	1.61	1.39	1.71	0.76	0.55	0.32	0.27	0.26	0.13	0.02	0.10	0.12	0.32	0.23	0.33	0.14
11	4.75	2.15	2.71	1.93	1.90	1.00	1.69	0.85	1.16	0.71	0.59	0.85	0.42	0.15	0.05	0.13	0.05	0.02	0.00	0.04	0.09	0.11	0.06	0.05	0.06
12	3.76	2.63	2.11	2.61	0.92	1.08	1.10	0.91	0.78	0.46	0.32	0.57	0.19	0.10	0.05	0.06	0.01	0.00	0.01	0.02	0.02	0.00	0.00	0.06	0.02
13	3.23	1.32	1.04	1.25	0.74	0.50	0.53	0.44	0.37	0.17	0.16	0.23	0.14	0.04	0.02	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.00
14	1.67	0.43	0.67	0.53	0.37	0.26	0.23	0.11	0.14	0.10	0.11	0.09	0.01	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	1.30	0.17	0.27	0.33	0.20	0.10	0.15	0.07	0.04	0.06	0.02	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.67	0.15	0.10	0.23	0.06	0.02	0.04	0.02	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.25	0.01	0.05	0.00	0.04	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.08	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unk	0.37	0.02	0.00	0.11	0.01	0.04	0.00	0.00	0.01	0.01	0.24	0.23	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.00	0.01	0.01	0.03	0.00
TOTAL	**337.97**	**115.53**	**98.75**	**90.39**	**66.61**	**81.78**	**94.84**	**59.33**	**90.54**	**67.04**	**62.77**	**69.93**	**28.35**	**27.76**	**18.44**	**29.27**	**25.86**	**21.66**	**22.65**	**16.84**	**17.07**	**12.64**	**9.94**	**7.51**	**5.26**

Table 13 Abundance at age (millions) from surveys in Div. 2J3K Campelen equivalents

Age/Year	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.62	0.00	0.00	0.00	0.00	0.35	0.00	0.80	0.91	0.53	0.00	0.66	0.00	0.00	0.00	0.00	0.90	0.22	2.30	1.37	0.56	1.06	1.82	0.80
2	0.00	0.00	0.68	0.52	1.08	0.40	4.29	11.53	4.56	2.87	10.59	5.50	0.00	0.69	0.07	0.00	3.14	10.55	3.56	2.09	4.93	2.92	2.79	3.37	3.52
3	10.84	0.56	3.95	6.57	18.20	23.21	7.07	13.43	77.09	24.12	16.96	29.54	6.75	3.87	4.07	4.74	2.54	6.10	23.85	5.86	6.16	5.68	5.16	5.01	6.55
4	169.86	21.45	6.07	18.30	21.04	34.60	57.31	23.48	73.34	77.74	32.81	49.00	17.22	19.91	8.13	17.37	14.45	11.82	37.35	15.00	10.23	6.22	7.27	4.92	5.04
5	330.19	99.15	36.96	57.39	66.99	65.37	68.39	67.69	61.22	56.94	101.30	71.51	34.05	47.22	27.09	43.79	23.10	22.23	42.40	34.45	27.44	18.46	13.65	9.11	5.60
6	415.76	202.44	116.69	172.25	125.15	136.13	134.51	102.89	100.40	86.29	73.15	138.34	69.84	59.20	38.67	59.97	42.75	31.97	27.83	34.10	29.93	24.58	15.98	9.97	6.35
7	346.15	223.01	299.06	225.75	252.56	247.40	152.71	145.82	108.04	75.82	67.35	94.93	76.78	44.21	33.97	29.88	57.65	27.16	9.87	18.01	25.71	16.48	13.68	8.00	4.35
8	166.81	157.52	163.68	170.40	241.51	203.73	169.46	117.16	88.07	56.62	60.15	63.52	41.84	25.56	14.84	17.57	20.10	12.97	2.27	9.07	12.87	9.79	7.57	7.13	2.96
9	122.99	74.28	72.38	57.91	175.86	81.37	82.44	72.07	60.52	34.51	39.32	45.67	28.43	10.85	6.01	4.34	4.58	2.67	0.68	5.09	5.29	4.44	3.67	3.80	3.14
10	57.83	34.14	39.86	44.36	62.47	51.01	31.25	22.84	24.99	16.75	20.18	17.54	15.03	3.97	2.12	1.97	1.51	0.68	0.14	1.20	1.23	1.71	1.44	2.19	0.97
11	28.70	13.51	20.62	12.64	23.14	23.86	16.80	8.98	8.08	5.91	7.54	9.84	4.88	1.39	0.67	0.81	0.27	0.11	0.00	0.41	0.54	0.55	0.57	0.36	0.61
12	21.88	16.59	17.04	12.27	13.11	9.77	7.79	7.28	6.03	3.75	3.14	4.55	2.77	0.71	0.38	0.32	0.06	0.02	0.04	0.10	0.11	0.03	0.00	0.37	0.30
13	18.44	8.99	7.83	5.05	8.74	5.55	4.84	3.52	2.71	1.43	1.39	1.47	1.24	0.24	0.14	0.01	0.01	0.00	0.00	0.05	0.03	0.00	0.00	0.10	0.02
14	9.05	2.86	4.82	2.07	4.02	1.92	1.42	0.71	0.87	0.60	1.47	1.36	0.13	0.13	0.04	0.00	0.00	0.03	0.04	0.04	0.00	0.00	0.00	0.00	0.00
15	6.79	0.90	1.65	1.28	1.25	0.73	0.81	0.31	0.25	0.28	0.10	0.28	0.12	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	3.39	0.60	0.66	0.89	0.48	0.09	0.15	0.10	0.00	0.09	0.00	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	1.23	0.05	0.28	0.00	0.21	0.03	0.06	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.28	0.10	0.14	0.13	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unk	1.07	0.00	0.00	0.63	0.07	0.14	0.95	0.88	0.01	1.28	0.00	0.05	0.00	0.15	0.01	0.00	0.00	0.05	0.08	0.14	0.04	0.03	0.13	0.17	0.06
Total	1711.30	856.80	792.37	788.41	1015.88	885.29	740.62	598.67	616.97	445.89	436.00	533.17	299.79	218.10	136.24	180.78	170.16	127.26	148.32	127.91	125.86	91.44	72.95	56.30	40.25

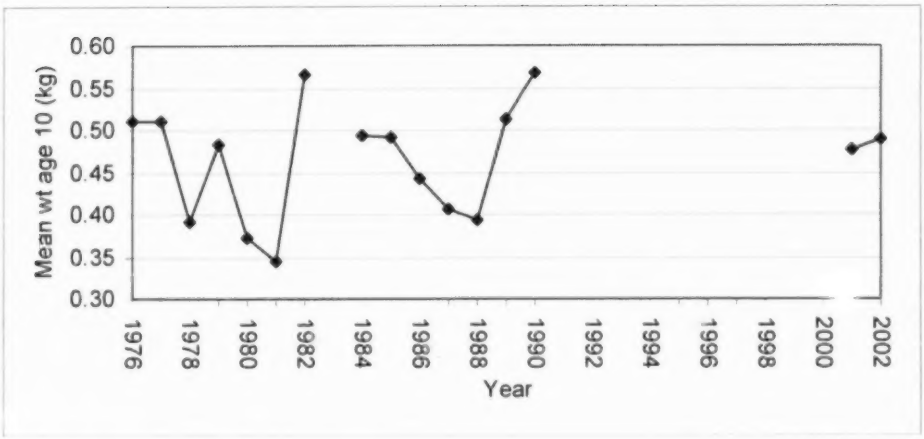

Figure 1. Mean weights (kg) at age 10, for American plaice caught in the commercial fishery.

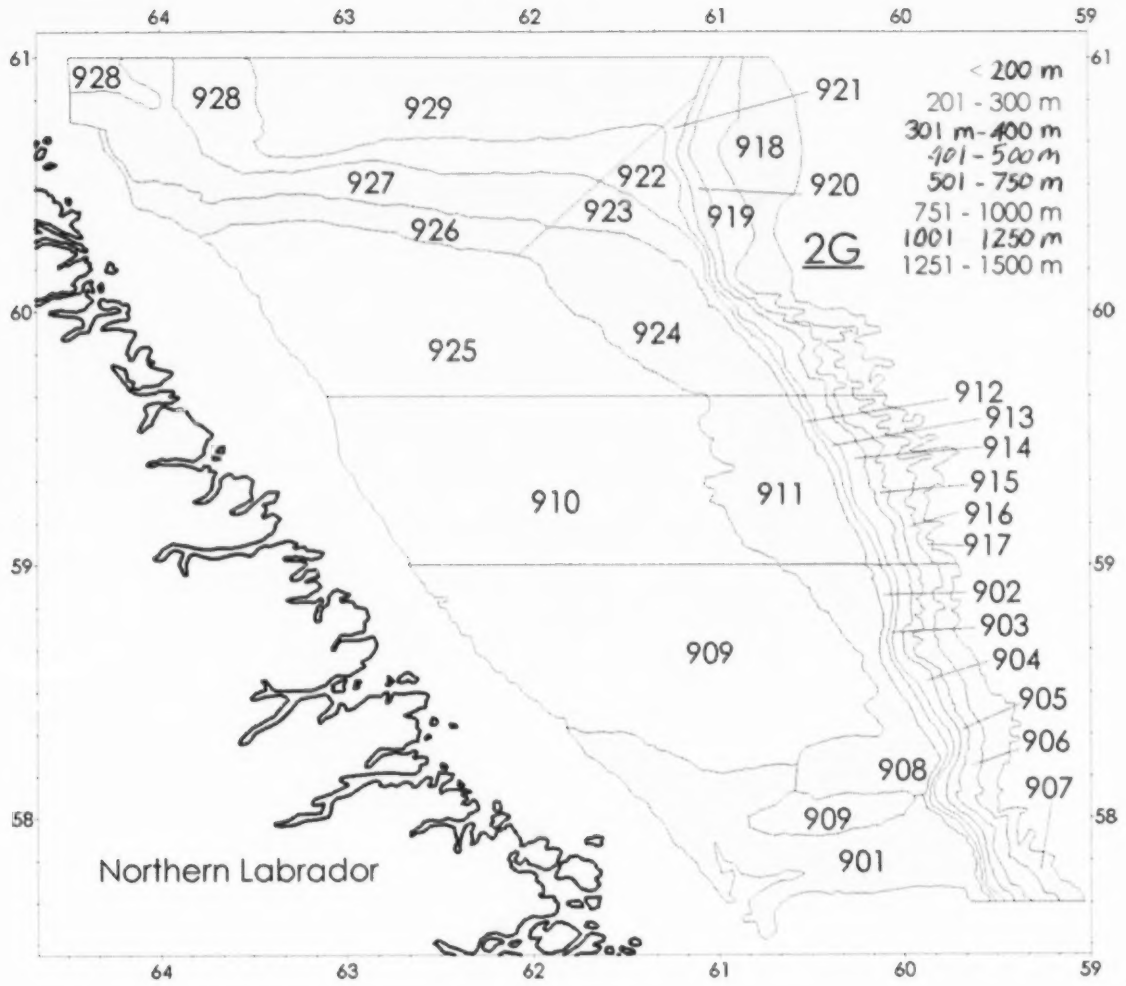

Figure 2. Stratification used in trawl surveys of NAFO Div. 2G.

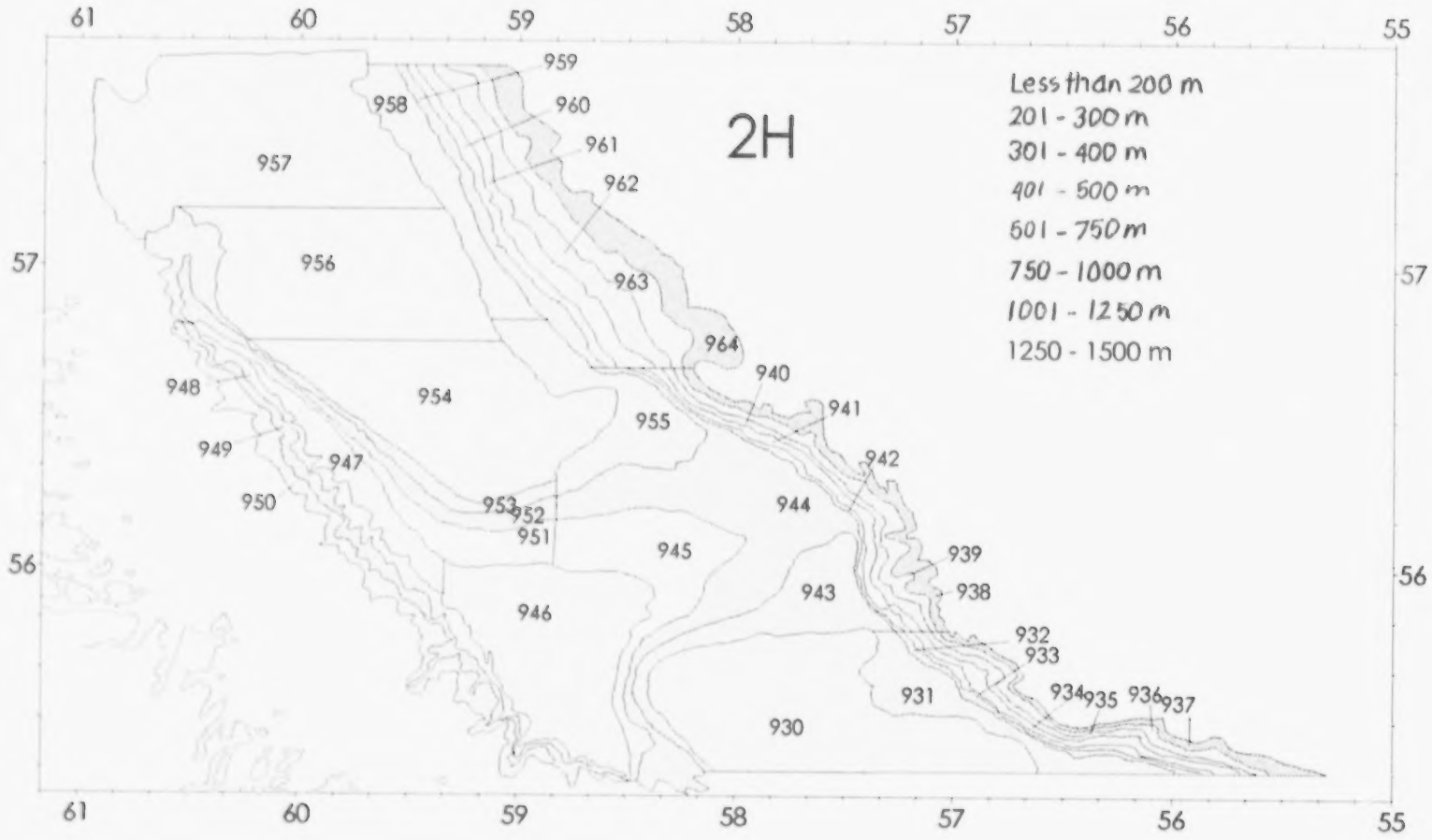

Figure 3. Stratification scheme used in trawl surveys in Div. 2H.

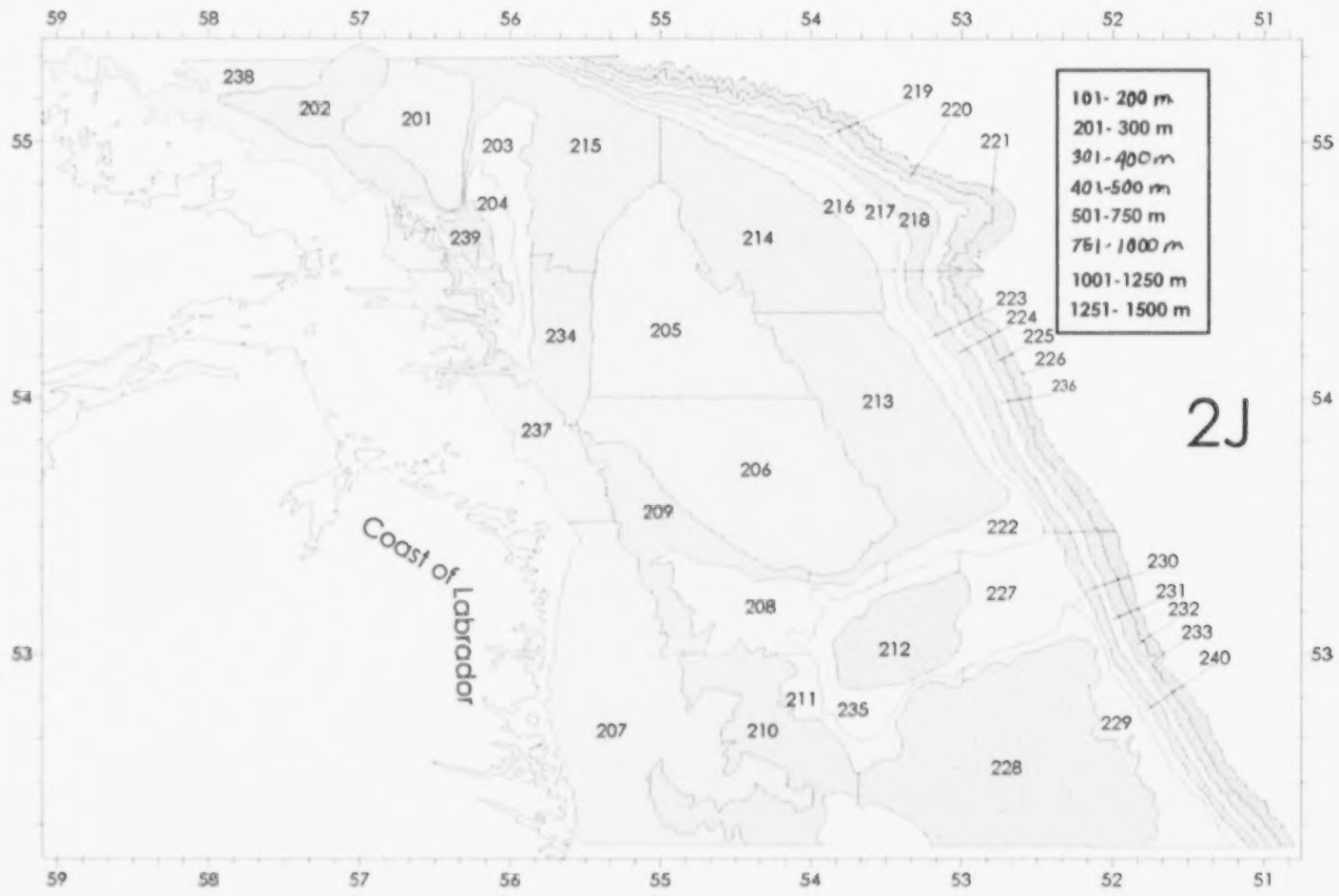

Figure 4. Stratification scheme used in trawl surveys of NAFO Div. 2J.

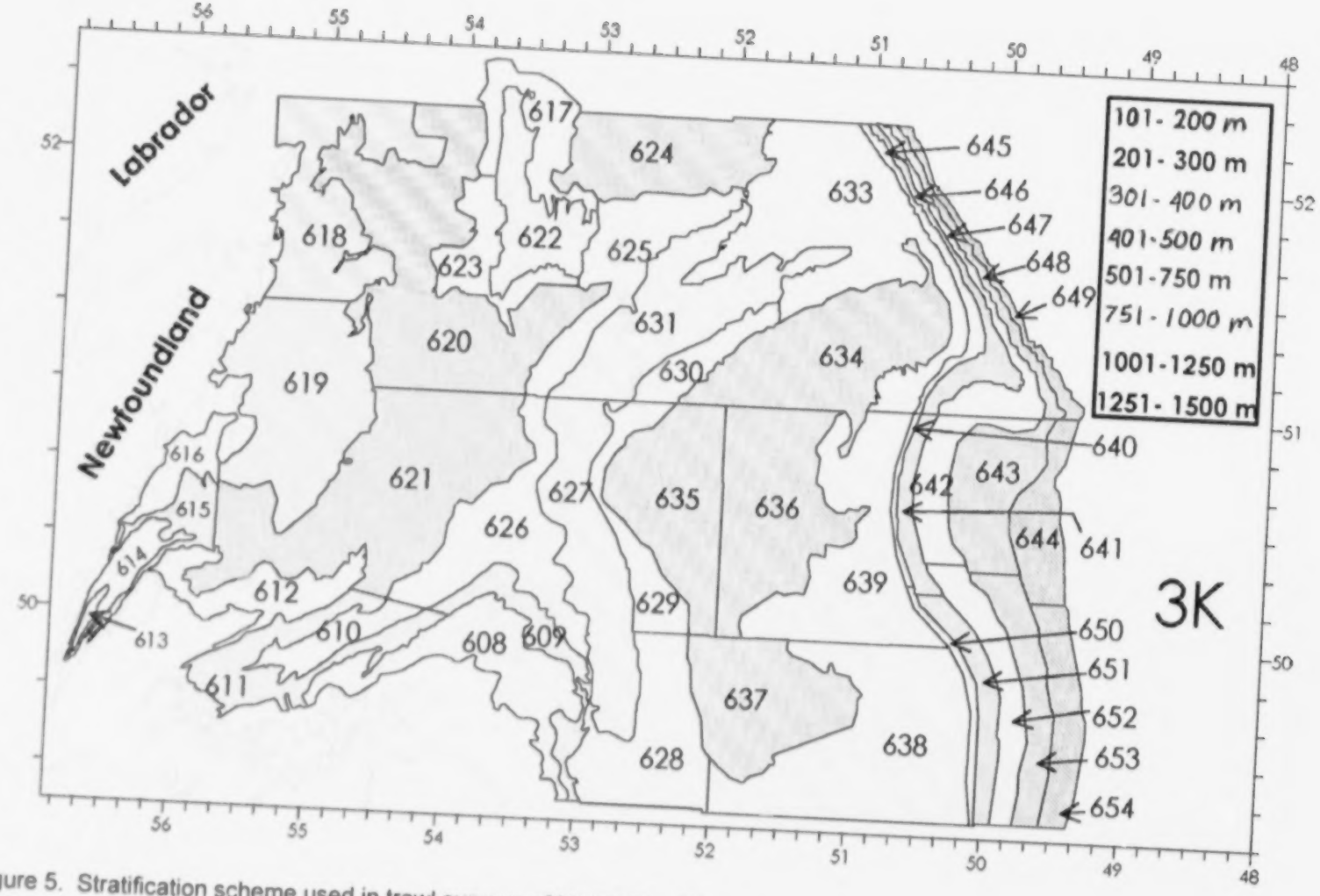

Figure 5. Stratification scheme used in trawl surveys of NAFO Div. 3K.

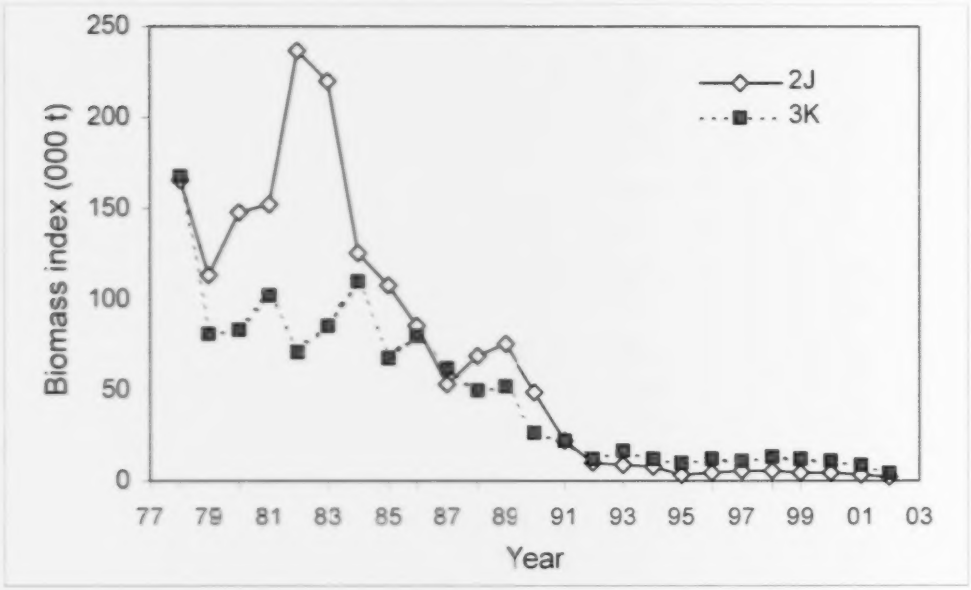

Figure 6. Biomass index (000 tons) of A. plaice, in Campelen units, from fall surveys, Div. 2J3K.

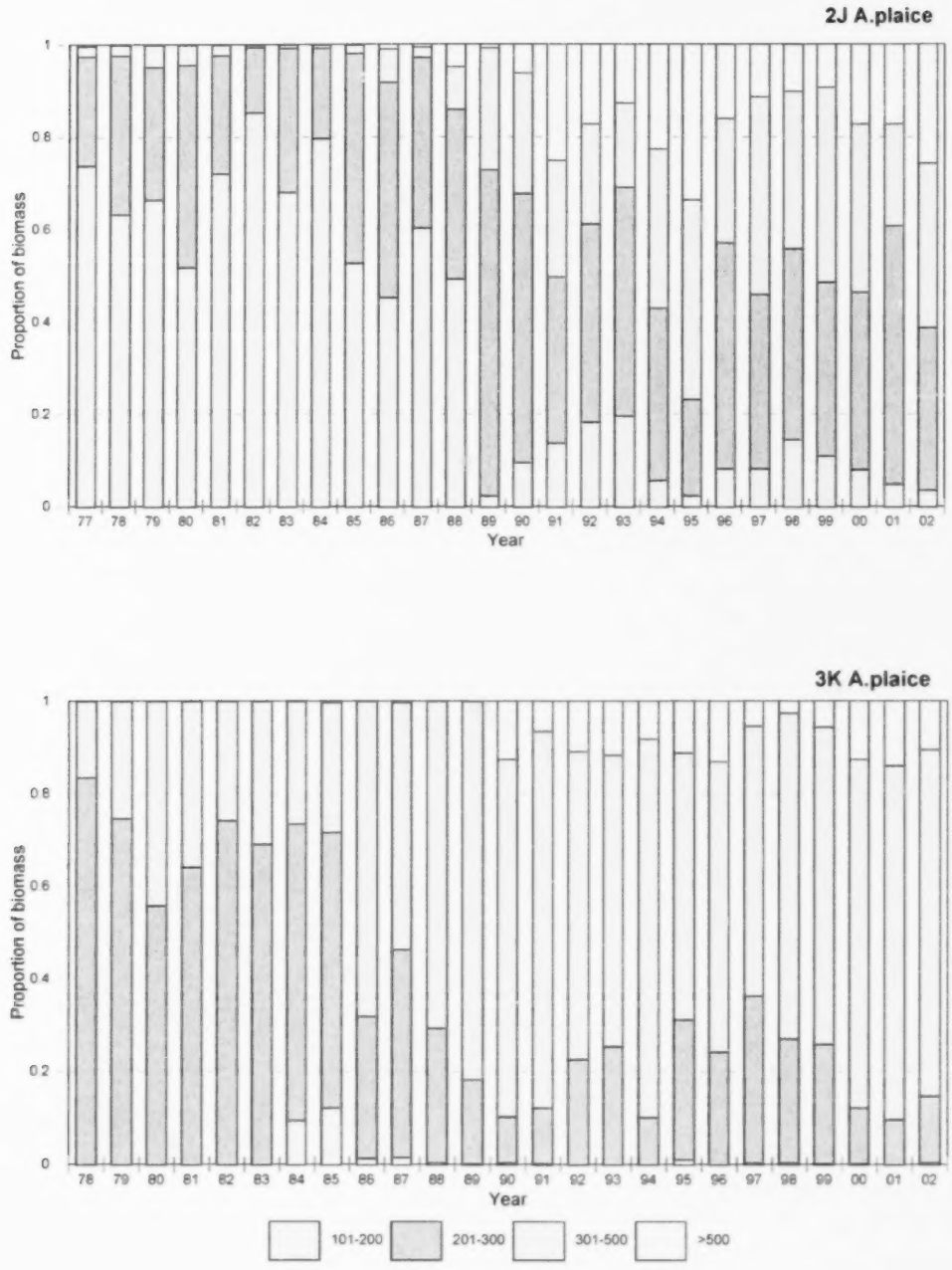

Figure 7. Proportion of biomass, by depth zone, A. plaice in Div. 2J and 3K. Surveys from 1977-84 are Engels trawl, surveys from 1995-2002 are Campelen trawl.

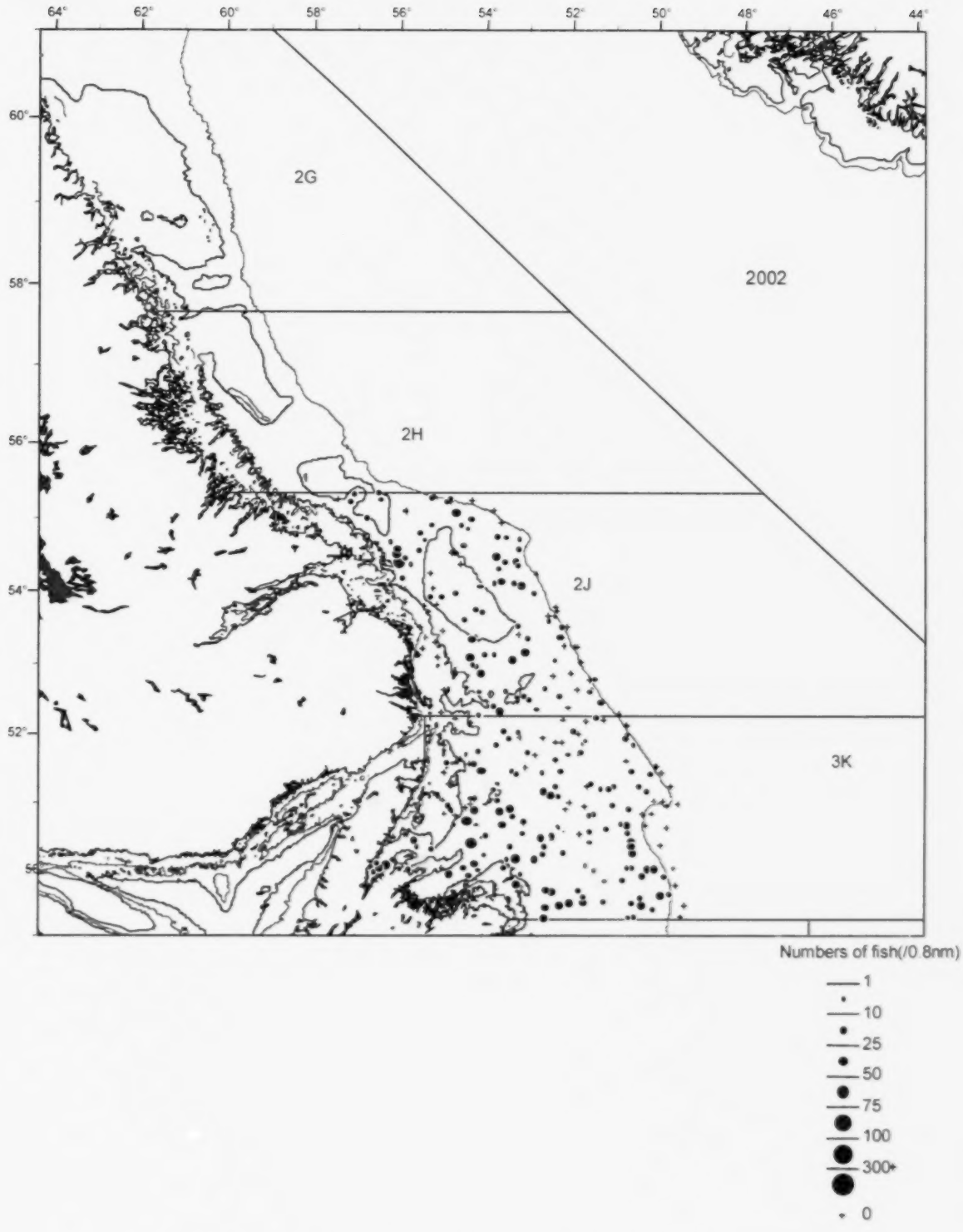

Figure 8A. Distribution of American plaice (number per set) in Div. 2GHJ3K.

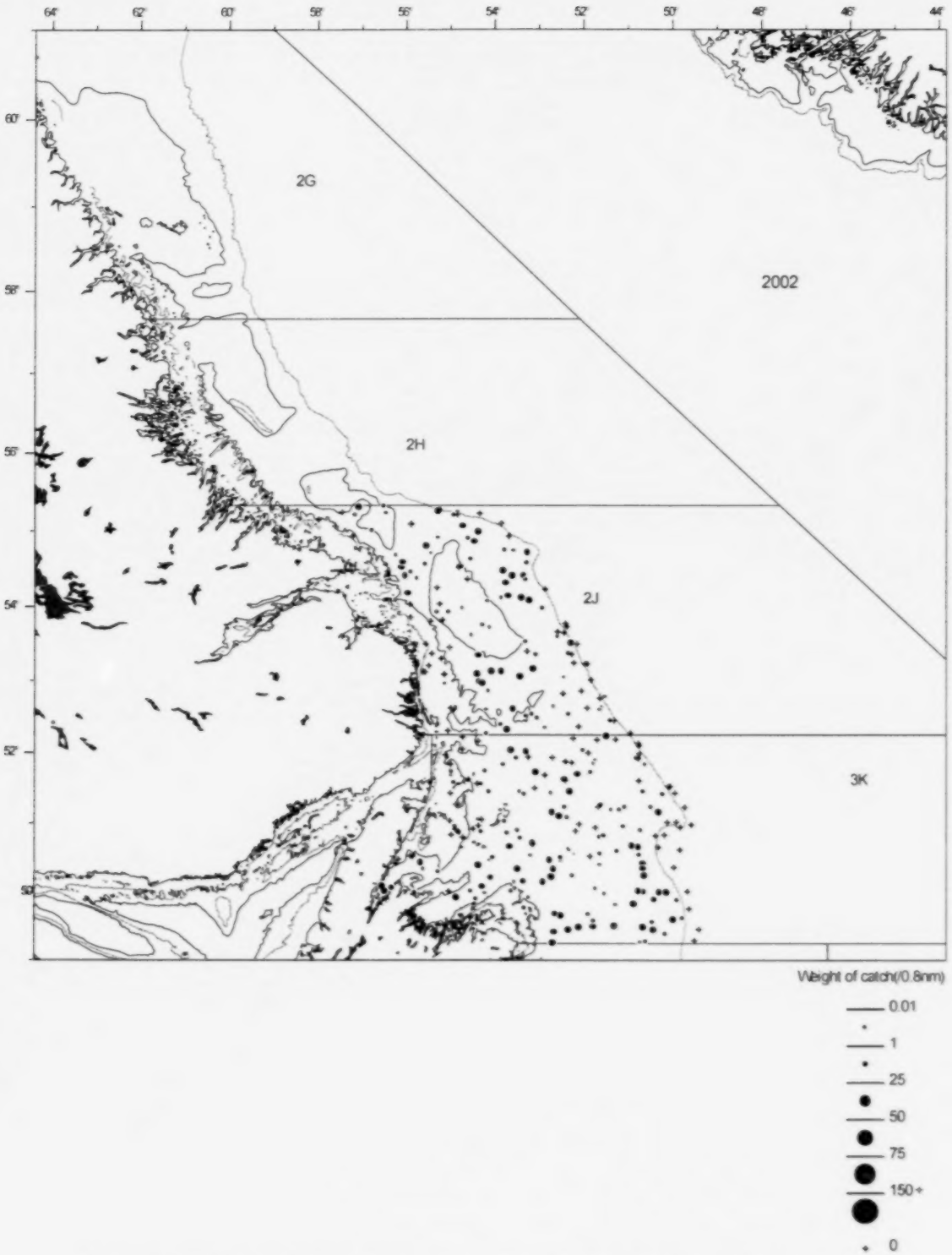

Figure 8B. Distribution of American plaice (kg per set) in Div. 2GHJ3K.

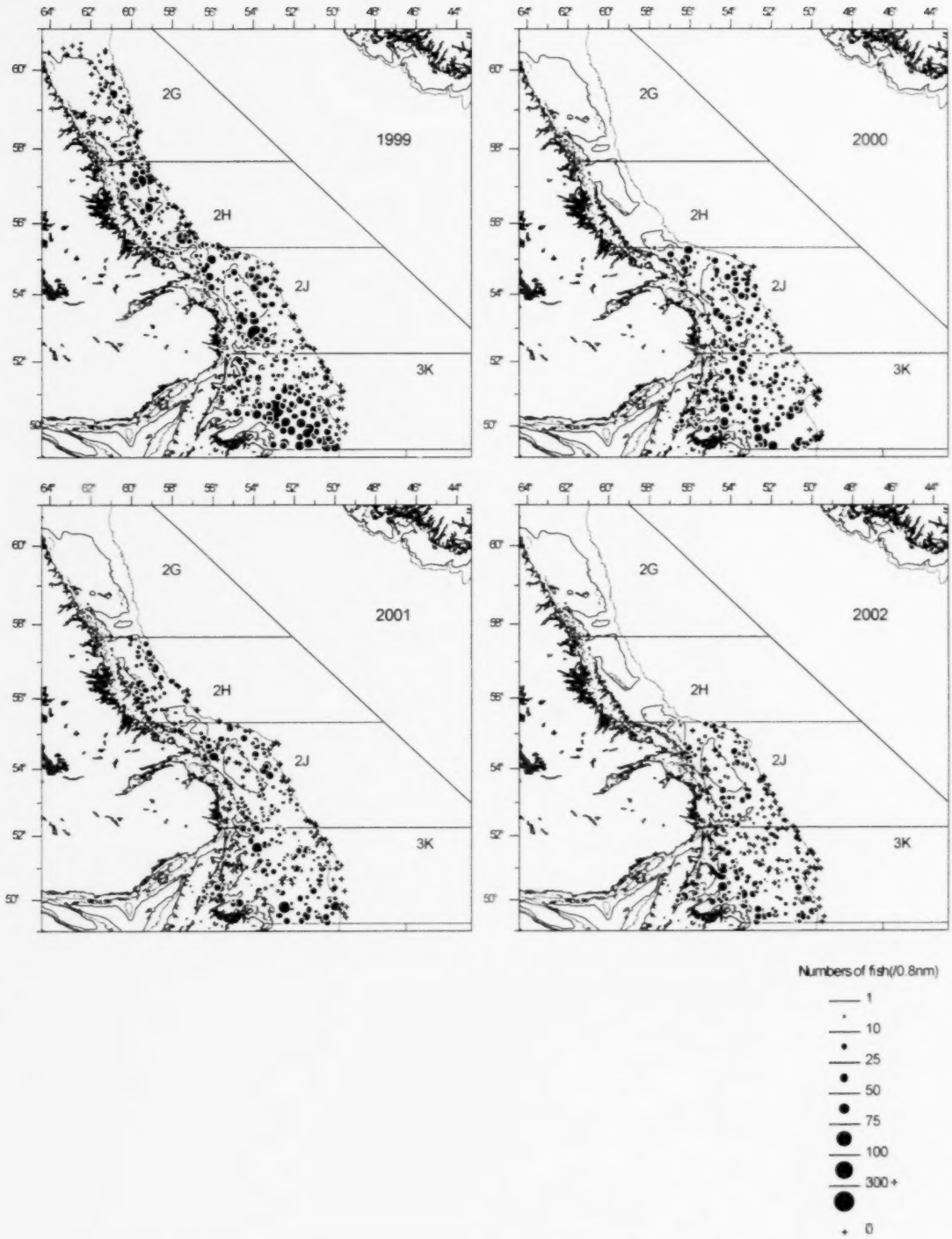

Figure 9. Distribution of American plaice (number per set) in Div. 2GHJ3K from 1999-2002.

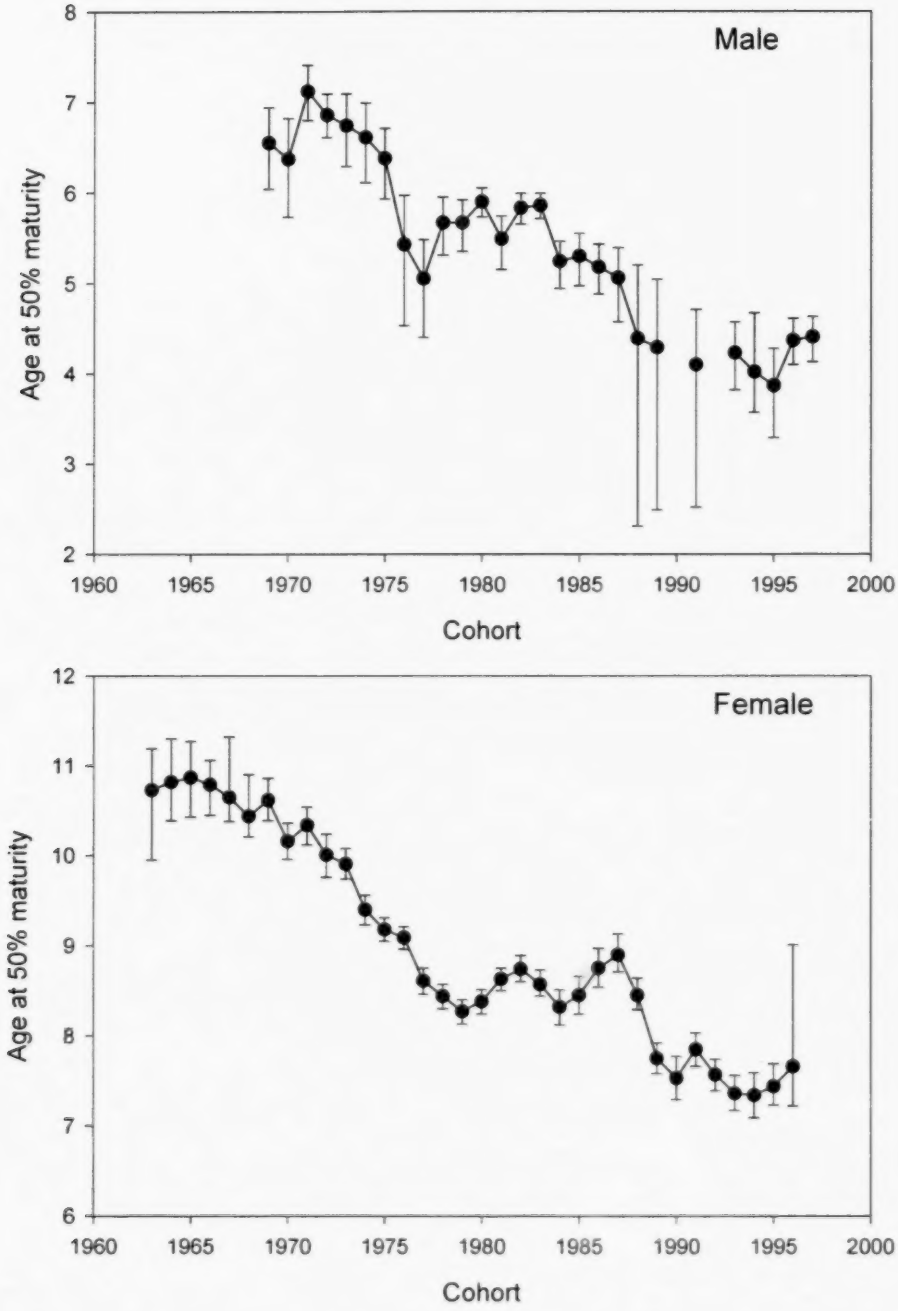

Figure 10. Age at 50% maturity for male and female American plaice in Div. 2J3K.

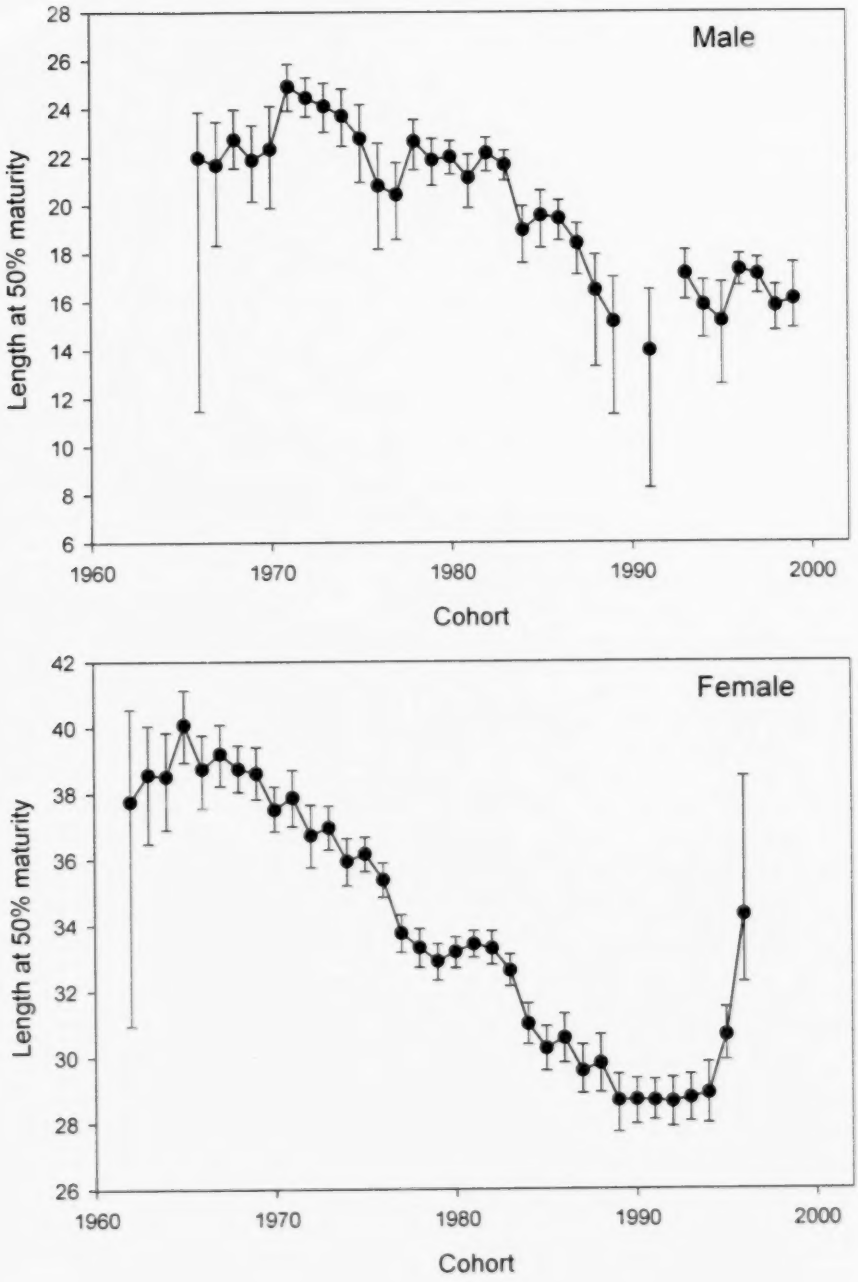

Figure 11. Length at 50% maturity for male and female American plaice in Div. 2J3K.

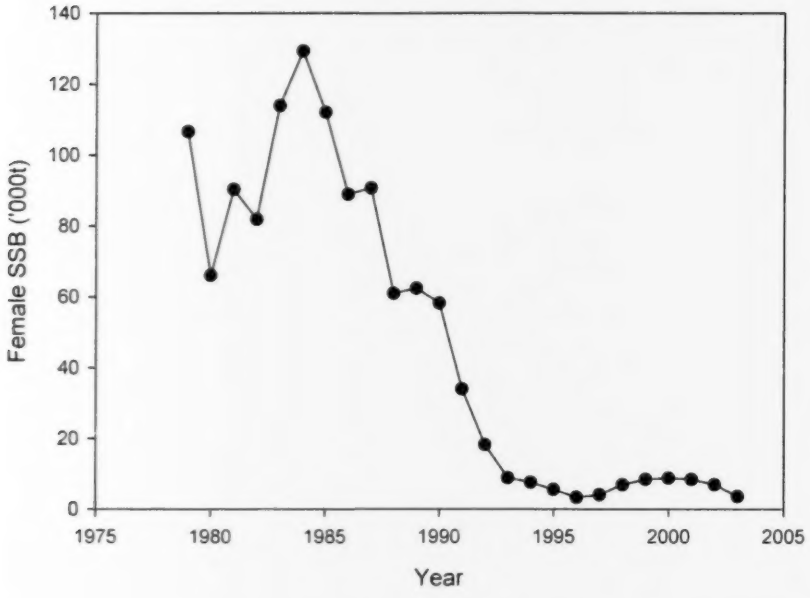

Figure 12. Female spawning stock biomass index from the fall surveys for American plaice in Div. 2J3K.

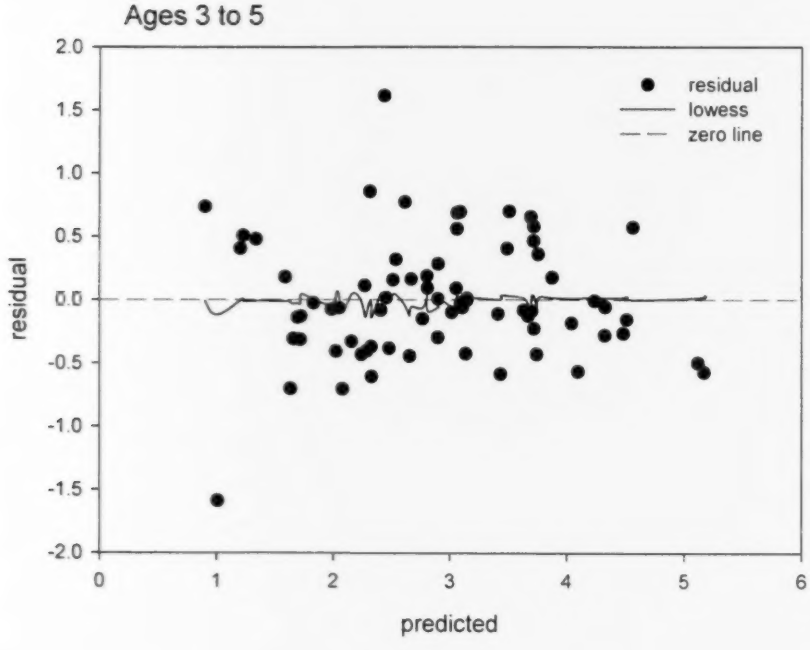

Figure 13. Residuals from the model of relative cohort strength plotted against the predicted value. A lowess smoother through the data is shown to indicate any trend. The zero line (no trend) is also shown.

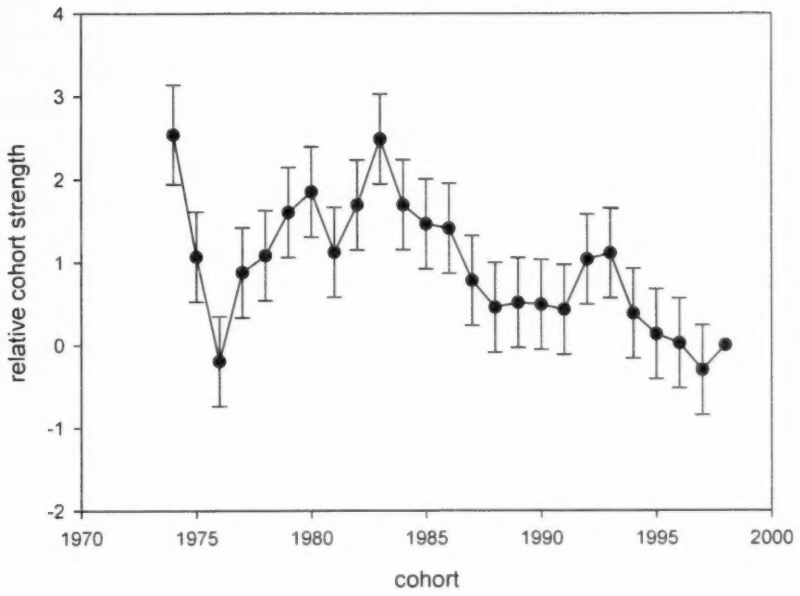

Figure 14. Parameter estimates of relative cohort strength (± S.E.) from the multiplicative model.

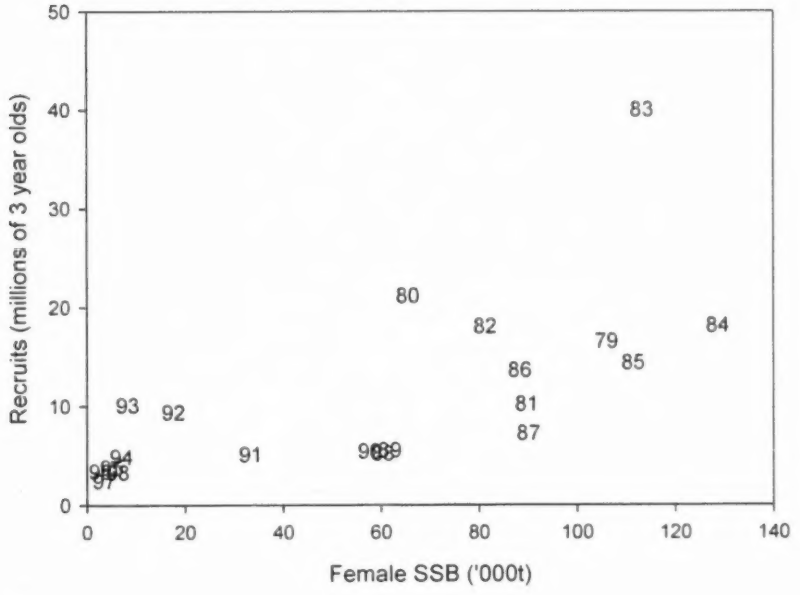

Figure 15. Recruitment (millions of 3 year olds) and females spawning stock biomass index from the survey for American plaice in Div. 2J3K. The symbols indicate the year class.

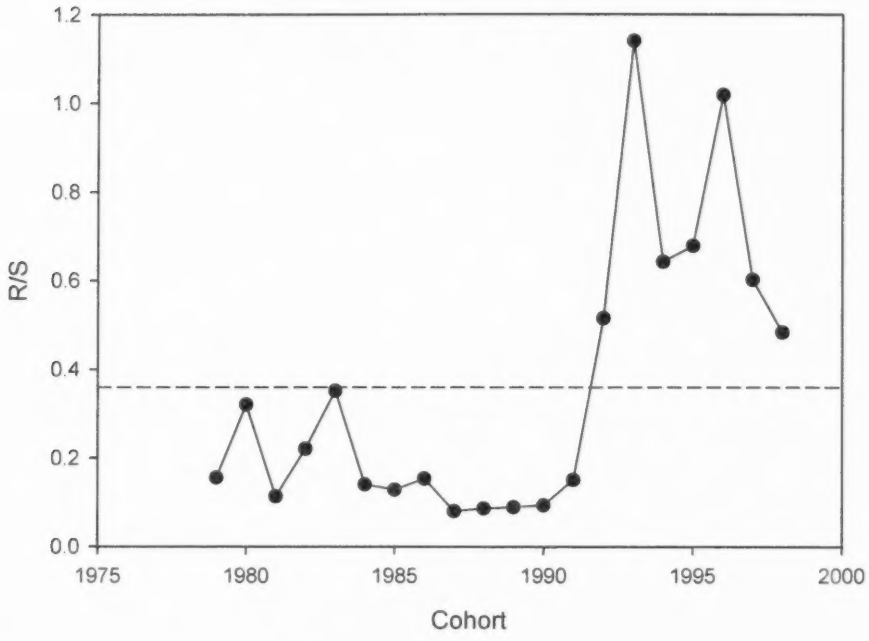

Figure 16. The number of recruits per thousand tonnes of female SSB index (R/S). The dotted horizontal line gives the average R/S.

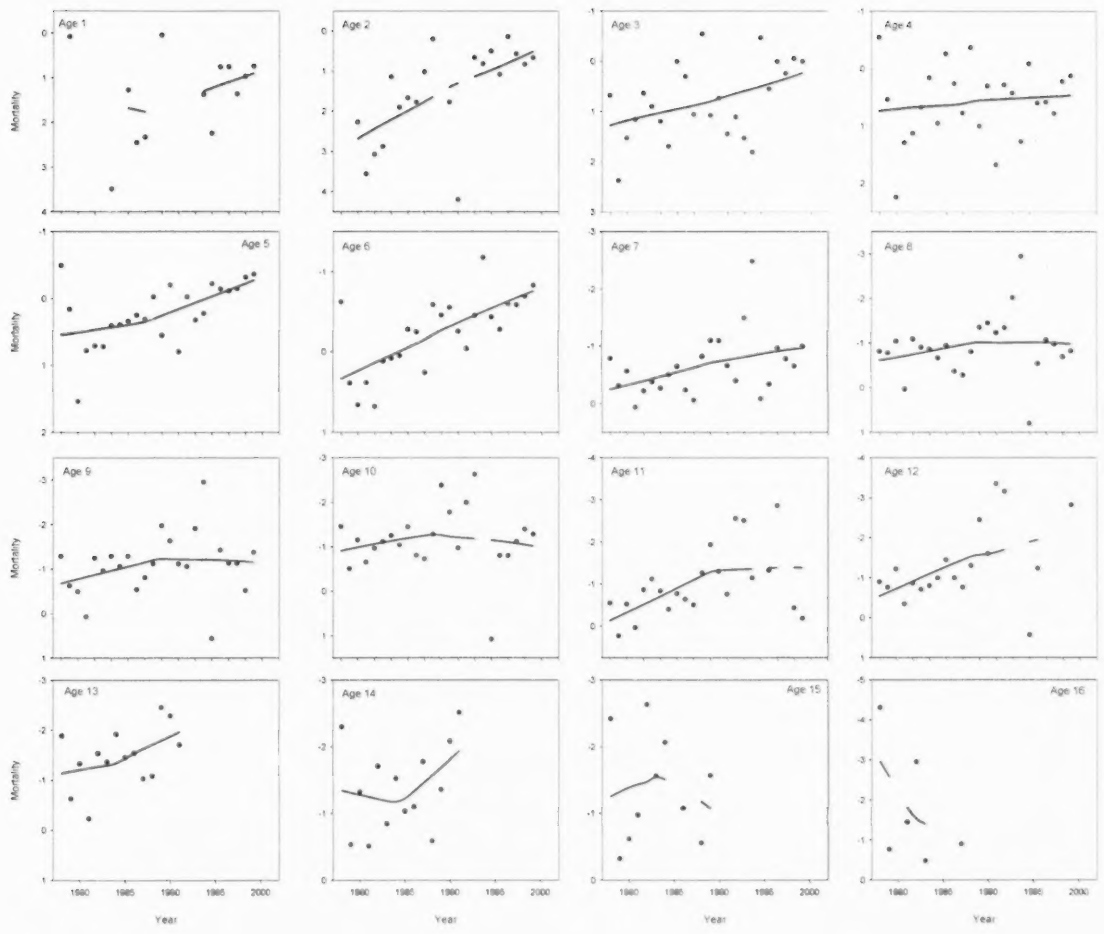

Figure 17. Mortality at age for ages 1 to 16 for American plaice in Div. 2J3K. The line is a lowess smoother to illustrate the trend.

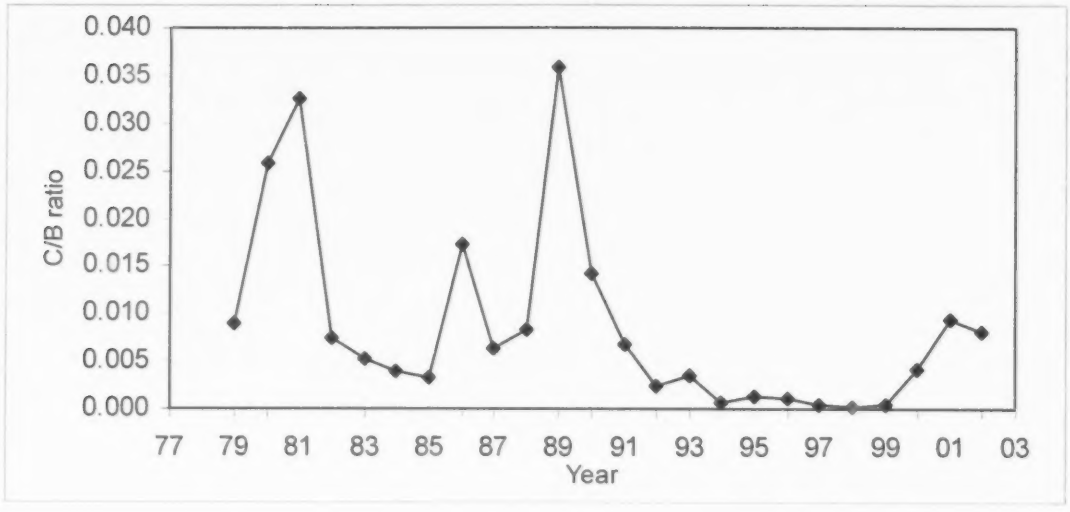

Figure 18. Ratio of catch (Div. 2+ 3K) to Campelen survey biomass (2J3K), American plaice.